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**The HOME FRUIT
GARDEN on the
NORTHERN
GREAT PLAINS**



**FARMERS'
BULLETIN
No. 1522**

U.S. DEPARTMENT OF AGRICULTURE

COLD and drought make fruit growing difficult and consequently limit fruit production on the northern Great Plains; but if a suitable site is chosen, hardy varieties are planted, and the plants are given proper care, a farmer in this area should be well repaid for his efforts to grow fruit for home use.

The hardier varieties of apples, crabs, plums, plum hybrids, cherry-plum hybrids, Bessey cherries, serviceberries (Juneberries), grapes, currants, gooseberries, raspberries, and strawberries and seedlings of the different native fruits can be grown with a greater or less degree of success depending on the district, site, and care given. Peaches, pears, apricots, cherries, erect and trailing blackberries, and nuts are not generally hardy; and, except for a few new introductions worthy of trial in sheltered sites, their planting cannot be advised.

First-class stock of hardy varieties from northern nurseries should be used. For the tree fruits, 1- or 2-year-old trees should be planted and low-headed or bush-formed trees developed.

The land should be well prepared, preferably by fallowing, so that planting may be done in moist soil.

Cultivation, pruning, spraying, protection from rabbits and mice, and winter protection are essential.

In most locations windbreaks are needed.

THE HOME FRUIT GARDEN ON THE NORTHERN GREAT PLAINS¹

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VALUE OF THE HOME FRUIT GARDEN

FRUIT GARDENS have been established slowly on the northern Great Plains, and those that have been planted are small. This has been a result not only of the climate but of a lack of knowledge of hardy varieties and of cultural methods adapted to the area. Many homes are without surrounding trees, shrubs, and flowers, all of which help to make a farm an attractive place on which to live. Such plants are of special importance to the farmer on the northern Great Plains, where most of the land is devoid of natural tree growth, winds are often severe, and fruits are scarce.

The value of the home fruit garden on the northern Great Plains is far greater than can be measured by its return in dollars and cents. There is a satisfaction in growing good fruit and picking it as it ripens in one's own garden that cannot be obtained by buying the same product. Moreover, the market supply of fresh fruit is often limited and the price high, and therefore the northern Great Plains farmer who depends on buying his fruit generally has less of it on the table

¹The information contained in this bulletin is based largely upon results obtained at the U. S. Department of Agriculture Northern Great Plains Field Station, Mandan, N. Dak.

than he should have, both for health and for the pleasure of a mixed diet. A liberal supply of fruit in the diet is decidedly beneficial. The fruit garden is an ornament to the farm, increases the value of the land, reduces grocery bills, and in favorable years may even add to the farm income, as any surplus should find a local market in this area where the supply of native-grown fruit is limited.

Commercial fruit growing probably will never be of great importance on the northern Great Plains. There are doubtless opportunities for farmers having experience and unusually favorable sites to grow fruits and vegetables for sale in local markets and to profit financially thereby, but this aspect of fruit growing is not considered in this bulletin. The problem of growing fruit for home use and its relation to the building of more permanent and more attractive homes on the northern Great Plains are believed to be of far greater importance than any commercial-fruit problem of the area.

That it is possible to grow fruit for home use in most of this area can no longer be doubted. Experience has shown that it is not easy, but fruit growing requires careful attention in any area if best results are to be obtained. This is especially true of the northern Great Plains, where climatic factors make fruit growing particularly difficult. However, many persons have been determined to grow fruit and when overtaken by failure have been willing to learn and to try again until they have achieved success. The experience of such persons and the results of work at State and Federal agricultural experiment stations clearly indicate that, given a suitable site, adequate protection from wind, hardy varieties on hardy roots, and cultural methods adapted to the area, the farmers on the northern Great Plains can grow fruit both to eat out of hand and to cook.

AREA AND TOPOGRAPHY

The northern part of the Great Plains, to which this bulletin applies, includes roughly the portions of North Dakota and South Dakota west of the one-hundredth meridian and the Plains sections of Montana and Wyoming east of the Rocky Mountains, except for the southern sections of Wyoming and South Dakota, which belong to the central Great Plains area (fig. 1).

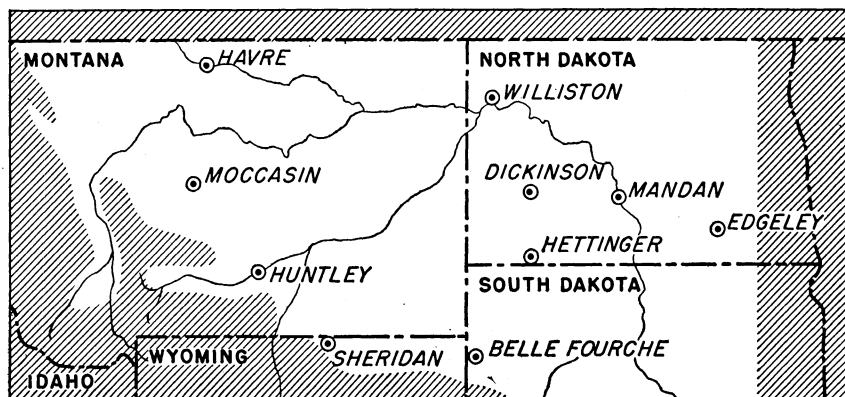


Figure 1.—Map of the northern Great Plains, showing by a dot within a circle the locations of State and Federal experiment stations.

Except for the Bad Lands districts, river valleys, occasional hills, and a few isolated groups of small mountains, the land is largely characterized by broad, rolling, treeless plains. Most of the area is drained by the Missouri River and its tributaries. The Mouse River drains a portion of it in northern North Dakota. Over much of the area there is a gradual rise in elevation from the east to the west and also as the distance increases away from the valleys of the Missouri and Yellowstone Rivers. Altitudes of 1,500 feet are common near the Missouri River in South Dakota, but the elevation rises to 5,000 feet or more as the foothills of the Rocky Mountains are approached.

CLIMATIC FEATURES

The climate of the northern Great Plains has been classed as semi-arid, although variable from year to year in both the amount and the distribution of the annual and seasonal precipitation. In general, the average annual precipitation decreases from east to west, ranging from 15 to 20 inches over most of the western parts of the Dakotas and from 10 to 15 inches over much of the Plains sections of Montana and Wyoming. Exceptions occur, as in the Black Hills, which is a district of comparatively heavier rainfall.

The precipitation on the northern Great Plains is characterized by comparatively heavy rains in late spring and early summer and light precipitation in the fall and winter. Normally, almost 50 percent of the annual precipitation falls in May, June, and July and the seasonal precipitation from April 1 to September 30, inclusive, ranges from 60 to more than 80 percent of the annual, being approximately three-fourths of the annual precipitation over much of the area. June is generally the month of heaviest precipitation.

From April 1 to September 30, inclusive, the seasonal evaporation from a free water surface ranges from about 32 or 33 inches near the Canadian border to 38 or 39 inches near the South Dakota-Nebraska boundary line.

This part of the northern Great Plains is subject to severe drying winds at all seasons. March, April, and May are generally the more windy months. The prevailing-wind direction is from the west or the northwest over a large part of the area. South winds during the summer are sometimes hot and dry and consequently very trying to horticultural plants.

The average date of the last killing frost in the spring varies from May 1 to 31 in different parts of the northern Great Plains, and the average date of the first killing frost in the fall varies from September 1 to 30. Thus, the average length of the frost-free period ranges from about 90 to 150 days. In most of western South Dakota and in districts close to the Missouri or the Yellowstone River in North Dakota and Montana the average frost-free period generally ranges from 120 to 150 days, whereas in other parts of the northern Great Plains an average frost-free period of only 90 to 120 days generally obtains. As a rule, the length of the growing season decreases with increases in altitude and to some extent from south to north.

This area is characterized by long, cold winters and short, warm summers. Winter temperatures of -40° F. or lower have been recorded at most of the Weather Bureau stations located on the northern Great Plains, and summer temperatures of 100° F. or more may be

expected except at the higher elevations, where lower summer temperatures and cooler nights prevail.

Some climatic factors that tend to make fruit growing especially difficult are—

Low annual precipitation and frequent periods of drought.

Long, cold winter.

Strong, drying winds, which may occur at any season of the year.

Dry atmosphere and a high rate of summer evaporation.

Comparatively short growing season, with the possibility of damaging frosts in either late spring or early fall.

Sudden changes of temperature, especially in the winter, and alternate freezing and thawing in the spring.

Light snow covering during the winter.

Occasional hail.

These adverse climatic factors may occur in many different combinations. Their combined effect is to make the northern Great Plains one of the most trying areas in the United States for fruits. Winter-killing probably results from a combination of drying, cold, and other factors rather than from low temperature alone. Young trees that have not become well established are especially subject to such winter injury. Many older trees that have been weakened by drought, competition with other plants, insects, diseases, overbearing, or mechanical injuries are unable to survive the cold winters and drying winds.

Periods of relatively low precipitation extending over several years may occur, as was the case over much of the area from the fall of 1932 until 1938. Drought damage was especially severe in 1934 and 1936, when annual precipitations at Mandan were only 8.13 inches and 6.43 inches, respectively. Records at Bismarck, N. Dak., extending back to 1875, show no other instance of the annual precipitation falling below 10 inches. It is not surprising that fruit plantings in the northern Great Plains suffered severely during this period of drought and some growers experienced a total loss, making it necessary to start all over again.

Those were exceptional years, however, and not all the climatic conditions are adverse. Fungus diseases and some insect pests are not so likely to be troublesome as in more humid areas. Clear skies and bright sunshine may cause sunscald on the southwest side of a tree during the winter and early spring, but they hasten the ripening of the fruit during the short growing season and give it a desirable color. Some fruit bushes, such as currants and gooseberries, do not thrive in the hot climate of the southern latitudes but flourish in the cooler climate of the north. Others, such as Bessey cherry (western sand cherry), are not adapted to humid areas but thrive in the dry atmosphere of the northern Great Plains. The obvious thing to do is to select fruits that are at least in some degree adapted to the climatic conditions that obtain and not attempt to grow fruits that lack hardiness or the ability to withstand periods of drought.

SELECTION OF A SITE

The selection of a site for the home fruit garden is of fundamental importance. If possible, it should be close to the farm buildings for convenience in properly caring for it and gathering the fruit and because it adds to the attractiveness of the home. However, if the

buildings are on poor, rocky, or alkaline soil, on the top of an exposed hill, on a steep south slope, or in a hollow or depression in which cold air or floodwaters are likely to collect, it would be better to select some other place on the farm where the soil and exposure are better suited to fruit growing.

Occasionally the site may be chosen to utilize runoff waters from higher ground during heavy rains. Furrows aid in diverting such floodwaters to the selected site; but if the slope is steep, washing of the soil may occur.

Comparatively level land is best suited for the fruit garden. A steep slope should be avoided, as cultural operations on it become difficult, water is lost by runoff during heavy rains, and washing of the soil is almost sure to occur under a system of clean cultivation. If irrigation is contemplated, it is especially desirable to select land that is fairly level, as it is very difficult to irrigate properly rolling or uneven land and steep slopes.

If sloping land is chosen, a north or northeast slope is to be preferred. On such a slope trees bloom later in the spring than on a decidedly south slope, thus tending to escape late-spring frosts; furthermore, trees and ground are not so subject to alternate freezing and thawing in the spring; a snow cover remains on the ground longer and protects the roots; there is better protection from drying south winds in summer; and the trees are less exposed in the winter and early spring to the bright afternoon sun, which often causes sunscald and ultimate death. Evaporation is greater from a south slope than from a north one; therefore, although each receives equal rainfall, plantings on the south slope are more subject to injury from drought. Native vegetation indicates the advantage of a north slope, as many hills have trees and brush on the north side, whereas only grass is found on the drier southern aspect.

Good air drainage is necessary, and fruit trees should never be planted in a hollow or pocket from which cold air cannot drain away to lower levels. Generally speaking, trees on the higher lands of a locality have a better chance of escaping frost damage in late spring or early fall than trees on the lower lands; but this does not mean that fruit trees should be planted on the tops of exposed hills. A well-drained coulee with a gentle slope would be much better, as it would afford a certain amount of protection from wind, catch more snow during winter, and supply more water. However, coulees with steep slopes should be avoided (fig. 2).

The soil should also be considered in selecting the site for the home fruit garden, although fruit trees and small fruits adapt themselves to a fairly wide range of soils and generally will succeed on land that is fit for general farming. A well-drained, fairly rich loam or sandy loam 6 to 8 feet in depth would be ideal, but either the more sandy or the heavier soil types will produce good fruit. Shallow soils less than 2 feet in depth, soils underlain by coarse gravel, rocky land, and alkaline soils should be avoided.

PROTECTION FROM WIND

A fruit garden on the northern Great Plains will thrive largely in proportion to the extent to which it is protected from wind. This protection may be in the form of natural hills or mountain ranges, native



Figure 2.—Part of an orchard planted in a coulee at the Northern Great Plains Field Station, photographed when 5 years old. Later soil-erosion problems developed in this planting.

timber, buildings, or trees planted for windbreaks. One of the most striking things observed in the horticulture of the area is that wherever fruit growing is successful there is also adequate protection from wind. If natural protection is not available—and it is not available to the great majority of northern Great Plains farmers—windbreaks should be planted and grown to a height of at least 5 or 6 feet before fruit growing is attempted (figs. 3 and 4).

Experience indicates that over much of the area protection from the prevailing west winds and from the hot, drying, south winds of summer is of major importance. There should be protection also from the cold, drying, north winds of winter. Protection on the east is of least importance.

A good windbreak protects the fruit garden from drying winds throughout the year; it prevents fruit from being blown off and limbs and foliage from being broken and lashed about by the wind; by making the air calmer it encourages bees and other insects which are essential to pollination to work freely at blooming time; it furnishes a home for insect-destroying birds; and it aids in collecting and holding an even cover of snow, thus protecting the roots during the winter. It is almost useless to consider growing fruit on the northern Great Plains without such protection.

The windbreak for the fruit garden should be one to five rows wide, the rows being spaced 10 to 12 feet apart, and, except for the outside row, the trees should be planted about 6 feet apart in the row. In the



Figure 3.—A windbreak protecting a small-fruit garden from west winds at the Northern Great Plains Field Station.



Figure 4.—A small-fruit planting with a plum orchard in the background and a windbreak at the right, Northern Great Plains Field Station.

outside row the trees should be 3 to 4 feet apart. An arrangement is suggested for a five-row planting, starting with row 1 at the outside (farthest from the orchard) and ending with row 5 on the inside (nearest the orchard). Trees having a low-branching habit are desirable for the outside row, and the Siberian pea-tree (*Caragana arborescens*) is one of the best of this type. Lilac (*Syringa vulgaris*) or Tatarian honeysuckle (*Lonicera tatarica*) may be substituted for the Siberian pea-tree in districts where insects are very troublesome to the latter. Row 2 may be Russian-olive (*Elaeagnus angustifolia*); row 3 American elm (*Ulmus americana*) or Chinese elm (*U. pumila*); row 4 green ash (*Fraxinus pennsylvanica* var. *lanceolata*); and row 5 choke-cherry (*Prunus virginiana* var. *melanocarpa*), wild plum (*P. nigra* and *P. americana*), or buffaloberry (*Shepherdia argentea*).

In a three-row windbreak, row 1 may be the same as in the five-row planting, row 2 either American or Chinese elm, and row 3 Russian-olive.

Russian-olives planted 4 feet apart form one of the best single-row windbreaks.

One or more rows of evergreens may be desirable on the inside, next to the orchard or buildings. Ponderosa pine (*Pinus ponderosa*), Scotch pine (*P. sylvestris*), jack pine (*P. banksiana*), Colorado (blue) spruce (*Picea pungens*), Black Hills white spruce (*P. glauca* var. *densata*), and Rocky Mountain juniper (*Juniperus scopulorum*) are considered the hardiest and best evergreens for this purpose.

A snow trap is sometimes advised to prevent snow from piling up within the windbreak and orchard and breaking the trees. However, if the first row of fruit trees is planted about 50 feet from the windbreak, most of the drifts will accumulate within the windbreak and between it and the fruit trees. The melting snow will benefit both, and the danger of breakage is not great. For these reasons, a snow trap is not advised under most conditions.

PROPAGATION OF FRUIT VARIETIES ²

Fruit varieties are propagated by vegetative means, as seedlings differ both from the parents and from each other. A few may be good, but most of them will produce fruit inferior to the parent. Most fruit trees are propagated by budding or grafting, but many small fruits are propagated from cuttings or root sprouts. As successful propagation requires considerable skill and experience, it is generally advisable to purchase plants from a reliable nursery.

ORDERING AND CARE OF NURSERY STOCK

It is advisable for prospective fruit growers on the northern Great Plains to obtain their planting stock from reliable nurseries situated in or near the district in which they live. Shipping charges are then less, the stock is more likely to arrive in good condition because of the shorter time on the road, and such nurseries are more likely to list hardy varieties suited to the district and propagated on hardy roots. Upon request a list of nurserymen will be supplied by the

²Detailed information on propagation is given in Farmers' Bulletin 1567, Propagation of Trees and Shrubs.

Northern Great Plains Field Station. Stock should be planted while it is perfectly dormant; that is, before the buds start to swell or the leaves to form. There is likely to be more trouble with southern-grown stock starting into growth before the land in the north is ready for planting than would be the case with northern-grown stock.

Nursery stock may be ordered for either fall or spring delivery; but if it is shipped in the fall, it should reach the farm before the ground freezes, so that it may be properly heeled in for the winter. By ordering early, either in the fall or early winter, the farmer stands a better chance of obtaining the varieties he wants before the nurseryman has exhausted his supply, and the shipment arrives in time for early planting.

Only first-class trees should be purchased. Such trees are not necessarily the largest, but they should be medium-sized, thrifty, and free from disease. Well-developed root systems should be insisted upon. Never buy small, weak, stunted, or diseased trees, no matter how attractive the price.

As a rule, 1-year-old trees are to be preferred to 2-year-old ones. They are cheaper, as good or better stands are usually obtained, and there is a better chance to form the heads low and to train the trees as desired. The nurseryman often trims 2-year-old trees in such a manner that it is very difficult to develop from them the low-headed or bush-type tree recommended for the northern Great Plains.

Shipments of nursery stock should be made by express or parcel post rather than by freight, as freight shipments usually are so long on the road that the roots dry out. The shipment should be called for promptly and inspected as soon as the farm is reached. If the roots or twigs appear dry, they may be freshened by being soaked for a day in a barrel of water placed in the shade or by completely covering the tree or plant with moist earth. Any trees with wartlike growths, called crown galls, on the roots should be discarded. Be careful not to let the roots dry out while the stock is being handled. It should be promptly heeled in, in a well-drained, cool place, as on the north side of a building, until planting time.

To heel in trees, a trench with one sloping side is dug deep enough to admit the roots. The trees in the bundle are separated so that fine, moist soil can be thoroughly worked around all the roots. Then they are laid down at right angles to the trench, with the roots in the trench and the tops near the ground on the sloping side. After the soil is packed around the roots the ground may be well watered as a further precaution against drying out, and then more soil thrown on until the roots are covered to a depth of several inches (fig. 5). If the trees are likely to remain heeled in for a considerable time, especially if they are buried in the fall to remain over winter, the tops should be partly covered with moist soil. Care should be taken that the soil around the roots does not dry out at any time, but it should not be waterlogged. Trees are left heeled in until planting time, but they should be planted before the buds start to grow. Vines and bushes are treated the same as trees.

CULTURAL METHODS

Fruit trees and bushes require care and attention wherever they are successfully grown, and cultural methods are of particular importance



Figure 5.—Trees heeled in, in moist soil, until spring planting time.

on the northern Great Plains, where the climatic conditions are adverse. The results depend largely on the care given. Many problems are yet to be solved, and the best cultural practice for one district may not always be the best for a neighboring district, or the best cultural practice for one season may not be the best for another. It is obviously impossible to give directions that will fit all conditions and all seasons, but it is believed that the general directions given in this publication will be of help in taking care of the home fruit garden.

PREPARATION OF GROUND

Half an acre to an acre of ground will generally be found sufficient for the home fruit garden. The land should be properly prepared for planting. Never plant on newly broken sod. It is best to crop such land for a year and then to fallow it for a year before planting the fruit trees and bushes. It is not considered advisable to plant after a small-grain crop. Either cultivated crops, such as corn or potatoes, or preferably clean summer fallow for a year should precede planting, as the stand and growth of the young trees and bushes will depend largely on the supply of water in the soil at planting time.

Summer fallow during the year before the nursery stock is planted is the best method for preparing land on the northern Great Plains. If properly handled, it will store needed water in the soil and at the same time effectively kill out grass and other weeds. Fallow should be plowed in the spring before the first of June and cultivated during the entire growing season as often as necessary to keep the land free

from weeds. A shovel or duckfoot cultivator is the best type of implement for the cultivation of fallow. The surface should be roughened by a cultivation late in the fall to aid in holding snow and to lessen soil blowing. The fallow should not be plowed again, as a firm, well-settled soil is best for planting nursery stock.

If the proposed site was cropped during the summer before the planting of the fruit garden, it should be plowed to a depth of 7 or 8 inches soon after the crop is harvested. The land should then be left rough over winter, as the rough surface protects the soil from blowing and tends to catch and hold drifting snow. If the soil starts to blow in early spring, it should be worked with some form of shovel cultivator which will leave the surface in a rough or ridged condition.

A dressing of well-rotted manure may be turned under at the time of plowing and would be especially desirable for light sandy land, for heavy clay, or for soils lacking in fertility. However, this is not necessary for most of the fertile soils of the northern Great Plains, where drought, cold, and wind, rather than the lack of plant food, are the factors limiting growth.

As an additional measure for holding snow and supplying water for the future trees and bushes, it is sometimes advisable to plow furrows along the lines where the rows will be or even to dig holes for the trees in the fall. The furrows or holes may be filled with snow, and thus the surrounding ground will be well moistened and in good condition for early planting when the snow melts in the spring. Furrows should not be run in the direction of the land slope, as washing is likely to occur.

If the orchard is planted on sloping land, terracing along contours to prevent surface runoff and soil erosion is desirable. Tree rows should follow contours so far as practicable, so that cultivation may be across rather than up and down the slope. Every effort should be made to prevent runoff, as the trees will require all the water that falls. One sees striking examples of fruit trees dying from drought on a slope, whereas the same varieties are healthy on nearby level lands.

PLANTING

It is especially important that trees be planted very carefully on the northern Great Plains, because much depends on their starting growth promptly and making a fairly vigorous growth during the first summer. Trees that are carelessly planted dry out, and many fail to grow; or if they start growth it is usually very late in the season, a weak growth is made during the summer, and they are very susceptible to winter injury.

As fall-planted fruit trees are in some danger of drying out and winterkilling during the long, cold winter, it is advisable to plant in early spring, soon after the frost is out of the ground. April planting is probably best over most of the northern Great Plains.

It is important in planting to see that the roots are always kept moist and not at any time exposed to the drying action of sun or wind. The roots may be wrapped in wet burlap while being handled in the field, or they may be puddled by dipping them in a thin mud made of a mixture of clay and water, which effectively prevents drying if the roots are not exposed very long. Some prefer to take the stock to the field with the roots in a barrel of water or thin mud.

The holes should be dug wide enough to admit the roots freely without bending or crowding and deep enough to allow planting the trees 2 or 3 inches deeper than they stood in the nursery row.

It is commonly advised to trim the roots carefully, but experiments indicate that this is not of great importance. Any unusually long root may be shortened, and if fine roots are numerous enough to interfere with the proper packing of the soil among them some may be thinned out. Large masses of fine roots indicate a disease called hairy root; trees showing such symptoms should be discarded. Trees should have good, vigorous roots, and ordinarily but little thinning out or root trimming is necessary. Broken ends of roots may be cut off smooth if desired.

Leaning trees slightly to the southwest is desirable, as the trunk is then less exposed to the afternoon sun, which often causes sun scald or killing of the bark on the southwest side of the tree. Some persons also advocate leaning the tree slightly toward the prevailing wind.

The most important detail of planting is to see that fine moist soil comes in close contact with all roots and that it is packed firmly around them so that large air spaces are eliminated. The first few shovelfuls are best packed under and around the roots with the hands; after that the feet may be used to advantage in packing the soil as it is thrown in. Do not throw the soil in loosely and merely pack the top; pack it firmly as it is thrown in, being careful not to break or bruise the roots.

Unless the soil has ample moisture, the trees should be well watered at planting time. A shallow trench, large enough to receive a bucket of water, should be left or made around each newly planted tree. After the water soaks in, the trench should be filled with loose soil. If planting is followed by several weeks of dry weather, it may be necessary to water again by the same method. Everything should be done to encourage the tree to start growth quickly and to become well established the first summer.

Small fruits are planted much the same as trees, except, of course, that the holes are smaller to correspond to the size of the root system. Bushes are planted a little deeper than they stood in the nursery. Strawberries should be planted at the same depth they formerly grew. The same care is necessary to prevent the roots from drying out, and because of their shallower root system it is even more important to water at planting time and to repeat the operation as needed until the plants become well established.

All fruit trees should be cut back when planted. If the trees are 1-year-old whips, they should be cut back to 15 or 20 inches from the ground. If 2-year-old trees or well-branched 1-year-old trees are planted, the branches that are to form the framework of the tree should be cut back to within 6 to 8 inches of the main stem and all other branches removed. Suggestions for selecting the main branches are given under Pruning Young Trees (p. 20).

Small fruits also should be cut back at planting time, as the top of the plant should be reduced to correspond to the loss of a large part of the root system. All blossom buds and part of the leaves should be removed from strawberry plants.

SPACING

There is little experimental evidence to determine the best spacing of fruit trees on the northern Great Plains. If the trees are widely spaced, each has a large area of soil from which its roots can draw moisture; but if they are closely spaced in groups or hedgerows, they may protect one another and hold snow. Perhaps each system has its place, and no rule can be laid down that will be best for all conditions. A spacing experiment was conducted at the Northern Great Plains Field Station from 1922 to 1940, but results were not conclusive. The closer spacing resulted in better stands and less winter injury in the earlier years but in heavier losses and more drought injury later. Apple trees widely spaced in the variety-trial orchard came through the drought of 1936 with less sunscald and in much better condition than the same varieties in closely planted blocks. In one closely spaced planting (fig. 6) drought injury and lack of vigor in the individual trees were noted about 10 years after planting. The fruits produced tended to become small and of poor quality as compared with the fruits produced in wider spaced plantings. To remedy this, about half of the trees were pulled out when the planting was 13 years old and others were removed later. Since this planting was thinned, the remaining trees, now 30 years old, have become more vigorous and fruits of satisfactory size and quality have been produced.



Figure 6.—Self-protecting fruit patch at the Northern Great Plains Field Station. The trees were planted in rows 12 feet apart and spaced 4 to 6 feet apart in the row. After drought injury became evident, the trees were thinned, with the result that the remaining trees became more vigorous and bore fruit of satisfactory size and quality.

Most of the evidence points to the advisability of planting fruit trees at standard distances. These distances may be a little closer than generally recommended for commercial fruit-growing sections, as few fruit trees grow very large on the northern Great Plains without irrigation. On low, rich lands with an underground water supply, greater distances than those given may be used to advantage. The following spacings are suggested for ordinary conditions: Apples and crabs, 23 to 30 feet; plums, 15 to 20 feet; plum hybrids, 12 to 16 feet; Bessey cherries, serviceberries (Juneberries), and grapes, about 8 feet each way, or in rows 10 feet apart with the bushes 8 feet apart in the row; currants, gooseberries, and raspberries, rows 6 to 8 feet apart, with the plants 5 feet apart in the row; strawberries, rows 3 to 4 feet apart, with the plants from 1 to 2 feet apart in the row.

However, if the site for the fruit garden lacks protection from wind and conditions are unusually adverse, it might be advisable to plant so that the trees would have every opportunity to protect one another and hold snow. Under such conditions trees may be planted in rows 15 to 25 feet apart and spaced 8 to 10 feet apart in the row or in groups of four trees, 2 feet apart, the groups being spaced 15 to 25 feet apart (fig. 7). The wider distances are suggested for apple and crab trees and the narrower for plum. In each type of spacing, bush-form trees should be developed; the branching should begin at or very near the surface of the ground. As a further protective measure, the rows may be run from northeast to southwest so that the closely planted trees will shade one another from the afternoon sun.

Under adverse conditions when other methods fail, close planting often results in a fair stand. If 25 percent of the trees fail to grow, the result is not so undesirable as it would be if wide spacing were used, because there is still a fair stand of trees. If a full stand is obtained, all the trees may be retained until their need for protection has passed, when a sufficient number of the weaker or less desirable trees should be removed before overcrowding begins.

Fruit trees should be planted at least 40 feet from the windbreak, and 50 feet would probably be preferable in most cases. The space between the fruit garden and the windbreak may be used for strawberries or a vegetable garden for a few years, or until the trees require all available moisture.

CULTIVATION

Referring to the relation of cultural practices to winter injury, J. H. Gourley, formerly of the Ohio Agricultural Experiment Station, made the following statement:

practices which maintain a strong vigorous tree and yet permit normal maturity are likely to reduce danger from winter injury.³

On the northern Great Plains one of the main problems is to keep the trees and other plants in a vigorous, thrifty condition and prevent their being weakened by drought, as many plants so weakened are unable to survive the winter. Consequently, clean cultivation through-

³ GOURLEY, J. H. TEXT-BOOK OF POMOLOGY. 380 pp., illus. New York. 1922. (See p. 275.) (Superseded by GOURLEY, J. H., and HOWLETT, F. M. MODERN FRUIT PRODUCTION. 579 pp., illus. New York. 1941.)

out the growing season is recommended. This should be frequent enough to prevent weeds from making any considerable growth. Besides preventing loss of moisture through weeds, clean cultivation, with a coarse, granular surface, facilitates the penetration of rain water, reduces runoff, and protects against soil blowing.

It is commonly advised to cease cultivation late in July or early in August in order to encourage early ripening of the wood and prevent a late sappy growth that might be susceptible to winter injury. It is doubtful whether this advice is sound on the northern Great Plains, except in unusually wet seasons or for young trees that may be growing too vigorously. As a general rule, there is no excess moisture in the soil in late summer or early fall, even when cultivation is continued. If it is not continued, bearing trees may suffer from drought in a dry season and enter the winter in a weakened condition. So it would seem best to start cultivation as soon as weeds begin to grow in the spring, ordinarily late in April, and continue it as needed until September. A man with a hoe should always follow the cultivator and remove weeds close to the trees and plants. Deep cultivation or plowing should not be necessary. The type of orchard cultivator shown in figure 8 leaves the surface of the ground in a ridged or furrowed condition, which is desirable to check soil blowing and kills weeds effectively if they are not allowed to get too large. As a further aid in checking soil blowing, furrows are often plowed between the rows late in the fall or early in the spring (fig. 9).

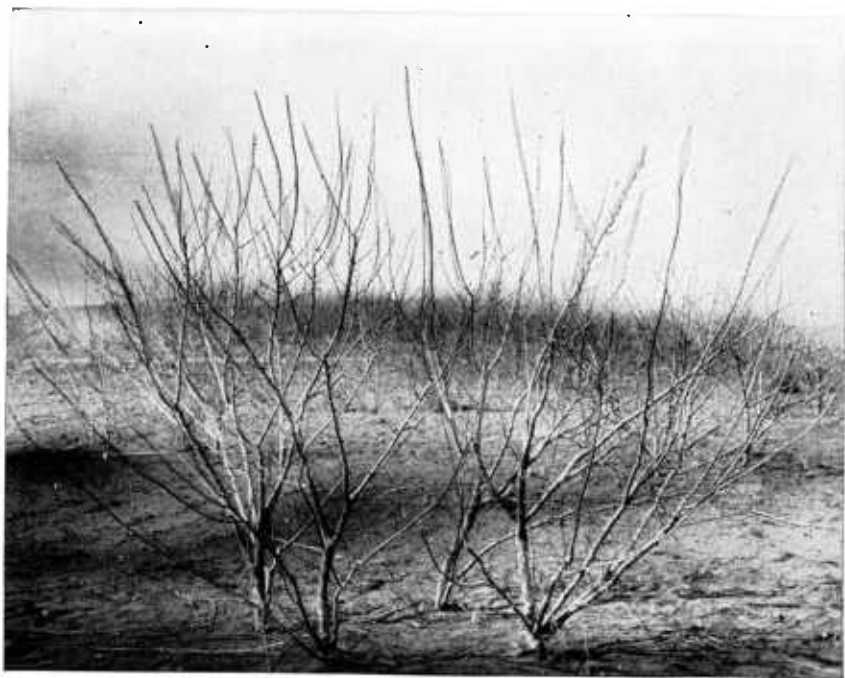


Figure 7.—Plum trees planted in groups of four in the planting-system experiment at the Northern Great Plains Field Station. This system is recommended only under special conditions.



Figure 8.—Orchard cultivator in use at the Northern Great Plains Field Station.



Figure 9.—Furrows plowed between rows of fruit trees to check blowing of a sandy soil.

A disk harrow or cultivator may be used to advantage after a cover crop or when there is considerable straw or other rubbish on the land, as it does not clog up so easily as the shovel type of cultivator. The disk is also less likely to catch and break roots. However, it tends to pulverize the soil and leave it in a condition favoring soil blowing, and if the gangs are not reversed in succeeding cultivations the soil is piled up excessively along the rows, and deep furrows are made between them.

In cultivating the orchard, care should be taken that neither horses nor implements break or bruise the trees, as such wounds do not heal readily in the dry climate of the northern Great Plains. If a tree is damaged, smooth the edges of the wound with a sharp knife and wrap it with burlap or some other material to prevent excessive drying. A coat of shellac or white lead paint and linseed oil may be applied to the wound.

If the slope is very steep, loose soil is readily washed away by rains, and cultivation may be impracticable. On such slopes a straw or hay mulch may be substituted for clean cultivation. This should be heavy enough to prevent weed growth, and care should be taken that fire does not start in the dry mulch. Each tree must be protected from mice by being wrapped with fine woven wire or by other means.

COVER CROPS AND MANURES

In most areas cover crops and green manures have a very important place in maintaining the fertility of orchard soils. In many instances continued clean cultivation has tended to deplete the humus supply of the soil—which is naturally low in semiarid areas—and finally has resulted in an unproductive orchard. In referring to experiments with cultural practices under irrigation conducted near Victor, Mont., H. Thornber⁴ wrote that—

continuous clean cultivation proved to be wholly unsatisfactory from the standpoint of either tree growth or fruit production.

He advocated plowing under green crops, preferably legumes such as clover, in order to maintain soil fertility and to prevent the exhaustion of organic matter.

Besides tending to keep up the supply of humus in the soil, a cover crop may prevent soil blowing at certain times of the year; and, if not plowed under until spring, it may aid in catching and holding snow in the orchard during the winter. In fact, there can be little doubt of the value of green-manure or cover crops in irrigated districts; but, in spite of the benefits derived, it is doubtful whether they can be recommended for the dry-land fruit grower on the northern Great Plains. Such crops compete with the trees for moisture and, by causing the trees to suffer from drought, may do far more harm than good. At least their use should be restricted to unusually wet seasons and to vigorously growing young trees. Small-fruit plants are planted so close that cover crops should not be attempted with them.

If a cover crop is sown, experience at the Northern Great Plains Field Station indicates that about the middle of July or a little later is the proper time for seeding. Oats, millet, and peas have been used

⁴ THORNER, H. ORCHARD CULTURAL PRACTICES. Mont. Agr. Expt. Sta. Bul. 156, 19 pp., illus. 1923. (See pp. 10-11.)

with fair success (fig. 10). The cover crop should not be planted within 6 feet of the trunks of the trees.

Whenever possible, it is desirable to use manure in place of cover crops to keep up the humus supply and fertility of the soil in the dry-land orchard. If a light dressing of well-rotted stable manure is applied every year, or even once in 2 years, there should be no ill effects from continued clean cultivation. However, manure does not readily rot under northern Great Plains conditions, and the excessive application of manure may actually injure the trees. Such results are evident in one of the cultural experiments at the Northern Great Plains Field Station, where blocks of trees that have been manured heavily over a period of years are in weaker condition than those in clean-cultivated blocks or in blocks receiving other treatments. There is evidence to indicate that the poor condition of trees in old manured blocks at Mandan is due to the manure bringing about a deficiency of available zinc after some 15 years of heavy application. Such a deficiency might occur in some soils, but not in others. The application of a straw mulch in the wintertime, combined with clean cultivation in the summer, has given good results in a test of cultural methods.

INTERCROPPING

Any crop grown between the fruit trees competes with them for moisture, and for that reason intercropping cannot generally be advised. However, if wide spacing (rows 25 feet or more apart) is used, a few rows of some cultivated crop or even one or two rows of small-fruit plants may be grown between the rows of fruit trees for a few years. A few rows of corn may be grown between young trees, and if the stalks are left standing over winter they afford some protection and aid in catching snow. The danger lies in continuing this practice too long, as the trees would be weakened by competition with the intercrop.

IRRIGATION

Although desirable, irrigation is not generally available to the northern Great Plains farmers and is not necessary for trees that are otherwise properly cared for. It is especially needed for such small fruits as strawberries and raspberries, which often fail under dry-land conditions because of drought.

If irrigation water is available, it may be used at any time that signs of suffering from drought are shown. Generally a good irrigation in May or June and another in July so that the fruit will become full-sized should be sufficient during the growing season. In dry years, a third irrigation is desirable late in the fall, when there is no danger of starting the trees and bushes into active growth. The later this is applied the better, as the object of this irrigation is to prevent drying out and consequent winterkilling during the long winter and the following spring. A straw or hay mulch applied soon after this late-fall irrigation will lessen evaporation.

It is better to irrigate thoroughly a few times than to apply frequent light irrigations. The soil should be wet to a depth of at least 4 or 5 feet at each irrigation. Either the furrow or the basin system of applying water may be used. A windmill or a small gasoline engine is sufficient to furnish irrigation water for most fruit gardens. If



Figure 10.—A cover crop of millet in the Hibernial apple orchard at the Northern Great Plains Field Station.

irrigation is contemplated, comparatively level land should be selected for the fruit planting, so that excessive leveling will not be required.

If there is higher ground above the site, runoff or floodwaters may be utilized for irrigation purposes by plowing furrows to divert the runoff water to the fruit garden. It may be desirable to terrace the orchard in order to prevent such water from running quickly away or washing the soil. In some orchards ridges are thrown up around or on the lower side of individual trees or groups of trees or bushes to aid in holding runoff water (fig. 11).

PRUNING FRUIT TREES

Pruning is often neglected in the home orchard or so done that the result is worse than no pruning at all. In considering pruning for the northern Great Plains, it is well to remember that large pruning wounds do not readily heal here and that the sunlight is more intense than in more humid areas; consequently, the branches should be left a little thicker, to shade properly the main limbs and trunk, particularly on the west and south sides of the tree. In other words, pruning should not be so severe on the northern Great Plains as in most other areas. It is better to practice a light annual thinning out of small limbs rather than any severe heading back or periodic removal of large branches. If a careful annual pruning is practiced from the start, removal of large branches should not be necessary.

Some objects of pruning are—

To influence the form of the tree.

To build a strong framework that will not easily break in the wind or under loads of fruit in later years.

To remove interfering, dead, or broken branches, water sprouts, and root sprouts.

To thin out top branches where they are too thick and produce more shade than is desirable for fruiting spurs and twigs in the center of the tree.

To thin fruits.

Pruning Young Trees

The purpose of pruning during the first few years is mainly to shape the tree as desired and to develop a strong framework. If well-branched trees are planted, the main, or scaffold, limbs are selected when the trees are pruned just after planting. If 1-year-old whips are planted, the scaffold limbs are selected the following spring. Suggestions for choosing the scaffold limbs follow.

Not less than three and not more than six main branches should be selected.

A low-headed or a bush-form tree is desirable (fig. 12). The lowest branch should be less than 1 foot from the surface of the ground and preferably on the southwest side of the tree. This will, of course, be impossible with trees that have been trimmed high in the nursery. A high-headed tree may suffer from sunscald (fig. 13). The main branches should start from the trunk at different levels; that is, there should be a vertical space of 4 to 6 inches between the different limbs (fig. 14, *A*). If two or more limbs leave the trunk at the same height, they are more likely to split down with a heavy load of fruit in later years.

The branches should be so arranged around the trunk that a symmetrical tree is formed; that is, each branch should point in a different



Figure 11.—Dirt embankment made to catch runoff water and prevent the washing of soil in an orchard near Hot Springs, S. Dak.



Figure 12.—A low-headed Virginia crab tree, Mandan, N. Dak.

direction. No scaffold branch should be directly above another. The horizontal arrangement of the scaffold limbs is shown in figure 14, *B*.

All scaffold branches should form wide angles (fig. 14, *C*) with the trunk of the tree, as sharp-angled branches (fig. 14, *D*) are likely to split down in later years; such splitting seriously damages the tree.

In removing superfluous branches, cut them off close to the trunk.

These suggestions refer to an ideal tree, which will seldom be found. The pruner should, however, keep such an ideal in mind and develop each tree as nearly like it as possible, remembering that every tree represents an individual problem.

The pruning after the second season's growth, or after the first season's growth if 2-year-old branched trees are planted, has for its main object the further development of a strong framework. One to three (generally two) well-placed branches are allowed to remain on each scaffold limb, and from a fourth to a half of the annual growth



Figure 13.—An old apple tree that had been headed too high, causing the bark on the southwest side of the trunk to be killed by sunscald.

is removed from them. If the branches are long and thin, they may be cut back more severely. If two branches that form a sharp angle are allowed to remain, one should be cut back more severely than the other to subordinate it to the longer branch. It is doubtful whether any further heading back is desirable, except possibly with plum hybrids or to suppress any limbs that may be growing too vigorously at the expense of others (fig. 15).

Little pruning is necessary for the next few years, except thinning out to prevent the formation of too many limbs and removing undesirable branches, such as one of two limbs which may interfere or rub each other, water sprouts, root sprouts, and dead or broken limbs.

Many young trees suffer severe winter injury, particularly during the first and second winters after planting. Some are killed back to the surface of the ground; the new sprouts that spring up may or may not be of the variety desired, depending on whether they start from above or below the union of the bud or scion with the root. The origin of such sprouts should be carefully determined and any from the root removed. One to four sprouts starting above the union of the scion and stock should be selected and used to form the framework of a low, bush-type tree. If one is selected, the pruning is essentially the same as on a newly planted tree. If all sprouts appear to be from the

stock, or root, it is best to pull the plant out and replace it with a new one from the nursery, as root sprouts probably will bear small, inferior fruits.

Pruning Bearing Trees

A light but regular annual pruning during the dormant period is recommended for bearing trees. This pruning should take the form

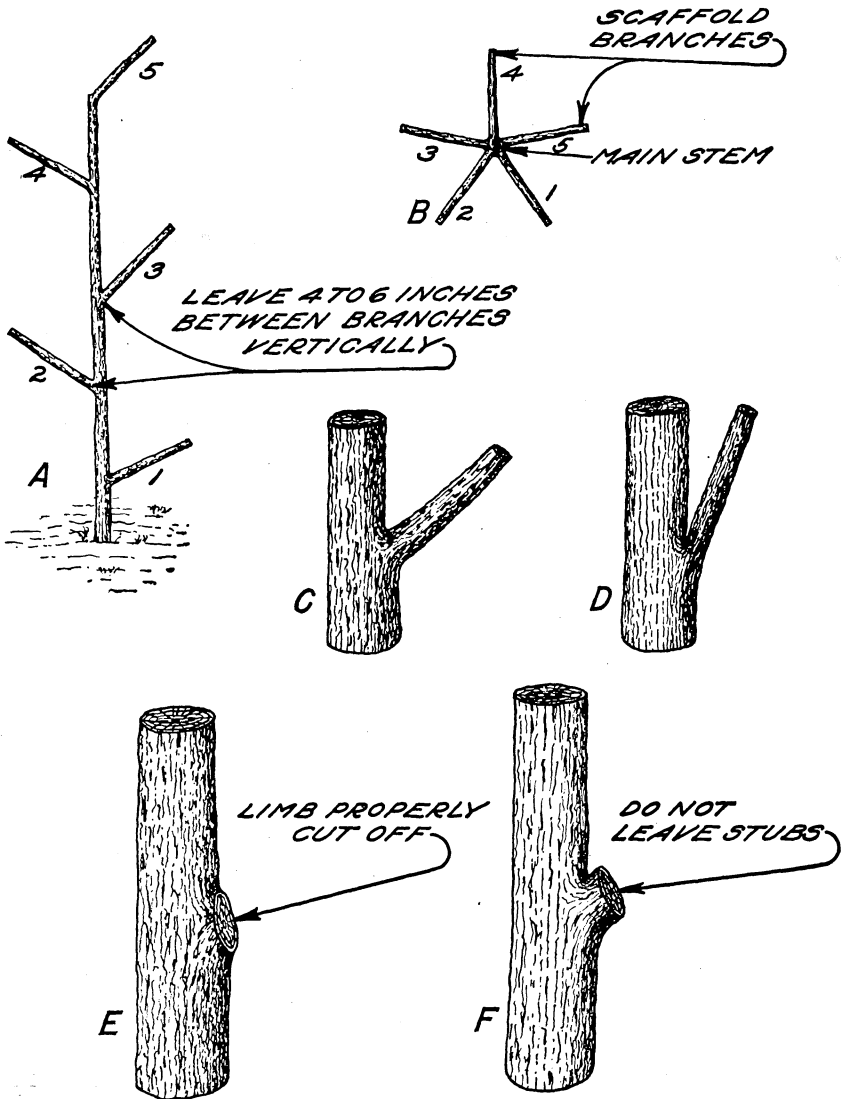


Figure 14.—A, Scaffold branches, showing correct vertical arrangement with no two leaving the trunk at the same height from the ground. B, Scaffold branches, showing horizontal arrangement around trunk, so as to form a symmetrical tree. C, Wide-angled branch of desirable kind. D, Sharp-angled branch, which is likely to split as tree grows older. E, Scar left by correct removal of a branch from a large limb or trunk. F, Stub left when a branch was not cut off close to trunk. Such stubs do not heal properly and permit the entrance of rot-producing or other fungi and of borers.



Figure 15.—A 3-year-old Hyslop crab tree (A) before pruning and (B) after pruning.

of a light thinning out of superfluous branches in the top of the tree, so as to admit light to the main limbs and the center. This encourages the formation of fruit spurs on the larger limbs, and the trees can hold heavier crops without breaking than they can when most of the fruit is borne near the ends of the branches. Heading back the annual growth is not generally advised, as it results in stimulating growth near the cut and in a thickening of the growth near the ends of the branches and consequently in more shading in the interior. At the Northern Great Plains Field Station severe pruning has in almost every case resulted in decreased yields without influencing to a marked degree the grade of the fruit. Varieties that tend to overbear, such as Opata cherry-plum hybrid and Desoto plum, may be pruned more severely, as this is one method of thinning the fruit (p. 28). In most cases, however, it is better to thin fruit by hand at an early stage of development than to depend on severe pruning.

Interfering limbs, water sprouts, dead or broken limbs, and root sprouts should of course be removed from bearing trees; and one of two branches forming sharp angles with each other should be removed or repressed by severe heading back. Keep the tree headed low and do not expose the trunk to sunscald by removing lower branches. If the tree has been properly pruned in earlier years, it will seldom be necessary to remove large limbs.

Pruning Wounds⁵

As previously stated, large pruning wounds do not readily heal in the dry atmosphere of the northern Great Plains; hence they should be avoided as far as possible. In removing a branch care should be

⁵ For further information on pruning wounds, see Farmers' Bulletin 1896, Care of Damaged Shade Trees, and U. S. Dept. Agr. Circular 656, Wound Dressings on Apple Trees. The latter publication is out of print but may be consulted in libraries.

taken to cut it off close to and parallel with a large limb or the trunk of the tree, as stubs do not readily heal over but remain bad places where rot-producing fungi gain entrance to the tree and weaken it or finally cause it to break or blow over (fig. 14, *E* and *F*).

A dressing that will disinfect the wound and protect it for several years from the entrance of fungi, but that will not injure the bark or interfere with the healing process is needed. Rather thick white lead paint is perhaps the most common substance used to protect pruning wounds. It should be mixed with raw linseed oil rather than turpentine, as the latter may injure the bark. The chief objections to paint are that it does not disinfect the wound and that it tends to crack and allow the entrance of wood-rotting fungi if not renewed from time to time. Shellac, pitch, grafting wax, melted paraffin, and asphalt paints are other substances used to protect pruning or other wounds on trees. Of these, shellac is believed to be one of the best, as it has given better results than white lead and linseed oil in several tests.

Trees injured by hail are pruned back severely, and the damaged parts are wrapped or painted to prevent excessive drying.

Season for Pruning

Early spring, just before growth starts, is ordinarily the best time to prune on the northern Great Plains. However, if there is evidence of severe winter injury, it is best to wait until after growth starts so that all dead branches may be readily detected and removed.

Tools for Pruning

A sharp pruning knife, hand shears, and sometimes long-handled pruning shears for larger branches are the only tools ordinarily needed for pruning. A pruning saw will also be found useful for removing dead limbs or for trimming trees that have been neglected, but the saw should seldom be required on trees properly pruned in their earlier years (fig. 16).

The pruning tools should be kept sharp and in good condition, as all cuts should be close, clean, and smooth.

PRUNING SMALL-FRUIT BUSHES AND VINES

It is fully as essential to give small-fruit plants a regular annual pruning as it is to prune fruit trees, if a high-grade product is desired.

Raspberries

The hill system of training raspberries is recommended for the northern Great Plains, where drought is the main limiting factor of crop production, if the bushes are not grown under irrigation. Wires are often used to aid in holding up the bushes. Two wires about 3 feet high and about 1½ feet apart are stretched, one on each side of the row.

As soon as the crop is harvested all old canes should be cut out, as raspberry canes bear fruit only during the second season. Five or six of the best canes of the current season's growth may be left to the hill. These canes will fruit the following year. Some prefer to cut these selected canes back to about 3 feet in height; such pruning encourages side shoots and does away with the necessity for a wire

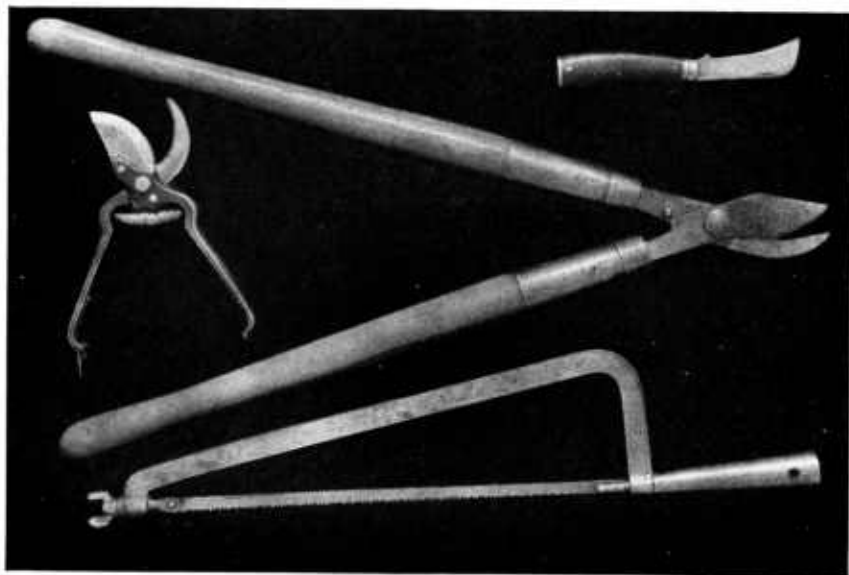


Figure 16.—Pruning tools of desirable types.

support. Cutting back is more commonly practiced on purple and black varieties than on red ones.

Currants and Gooseberries

Little pruning, except a light thinning out of the weaker shoots and branches, need be given currants for the first few years. After the bushes become older, pruning is essentially a renewal process; old wood that has borne fruit for several years is removed and vigorous new wood selected to replace the old. All wood over 4 years old should be removed. Heading back or thinning out of individual branches is not generally practiced, but the whole shoot is removed close to the ground after it becomes old and weak.

A good plan for currants is to develop a bush with nine shoots; according to that plan three 3-year-old, three 2-year-old, and three 1-year-old shoots are left after each annual pruning. Each year the three oldest canes are removed and three of the most vigorous new shoots are selected to take their place.

Pruning gooseberries is essentially a thinning out and renewal process as with currants; weak older wood is removed and vigorous new wood left for future fruiting. Individual branches of the gooseberry are sometimes thinned out if the growth is too thick, but there is not so much cutting out of shoots close to the ground as with currants.

Currants and gooseberries may be pruned either in the fall or in the spring; but late-spring pruning is recommended, as wood killed during the winter can then be removed. The thick branches protect one another to a certain extent and hold snow during the winter.

Grapes

Grapes require a heavy annual pruning, as the fruit is borne on new wood of the current season's growth. Many different systems of

pruning, including the standard 4-cane Kniffin method, are used. Experimenters in Minnesota⁶ have found that a modification of this system, to provide 6 fruiting canes, 3 on either side, on a 3-wire trellis (fig. 17, *A*) gives better results in Minnesota than the 4-cane system. Their experiments show that a maximum of 20 to 25 feet of fruiting wood, or 70 to 90 buds, should be retained to give improved yield with very little decrease in berry size.

However, all varieties of grapes grown on the northern Great Plains benefit by being laid down and covered with soil during the winter, and the system illustrated in figure 17, *B*, has often been found to be advantageous under such conditions. With any system, superfluous canes are removed and the selected canes are cut back severely each year. The vines should be pruned late in October, just before being covered for winter.

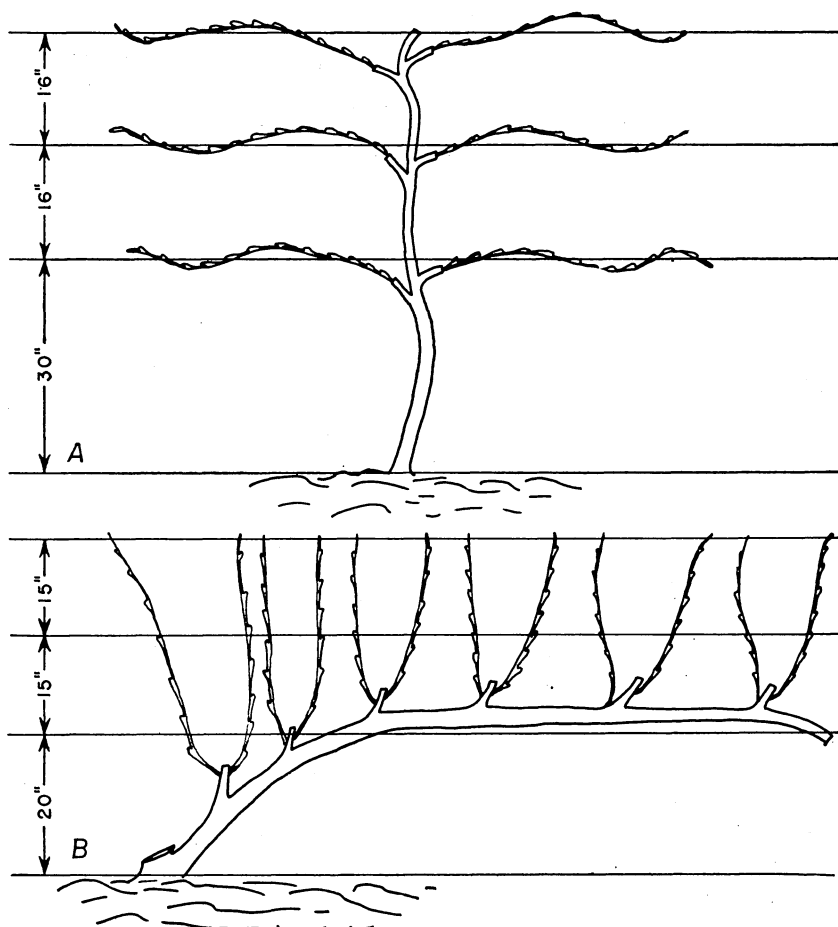


Figure 17.—*A*, Hardy grapevine pruned by six-cane Kniffin system advocated by Minnesota Agricultural Experiment Station. *B*, Grapevine pruned in a way to facilitate laying it down and covering it with soil to protect it over winter.

⁶ BEIERLY, W. G., and ALDERMAN, W. H. GRAPE GROWING IN MINNESOTA. Minn. Agr. Expt. Sta. Bul. 297, 20 pp., illus. 1933.

PRUNING NATIVE FRUIT TREES AND SHRUBS

Little is known about the pruning methods best suited for plants of such native fruits as serviceberries (Juneberries), Bessey cherries, chokecherries, buffaloberries, and American cranberry bushes. Generally little or no pruning is done, and it is likely that a light thinning out where the growth is too thick is all that is necessary. Severe heading back or pruning of the lower limbs is not recommended.

Whenever tried, severe pruning has resulted in decidedly decreased yields at the Northern Great Plains Field Station.

THINNING FRUIT

The practice of thinning fruit is generally neglected, or sometimes it is done so late in the season that little benefit results. If fruit trees on the northern Great Plains are to be kept in the vigorous vegetative condition desired, however, it is very important that they do not overbear. Overbearing results in small fruit of poor grade, large limbs broken by the weight of the crop, individual fruits not well covered by sprays, and trees so weakened that they may be very susceptible to winter injury.

It is important to thin fruit early in the season, commonly just after the so-called June drop or natural thinning out of fruit that often occurs in early June. Plums should be thinned before the pits harden. (See also p. 24.)

The details of thinning call for some knowledge of varieties, as the fruits of large-fruited varieties should be left farther apart on the limbs than those of small-fruited varieties. Two branches of the same size might be strong enough to hold six Wealthy apples or two dozen small crabs. The fruits on weak branches that are likely to break should be thinned out more heavily than those on strong branches. In general, apples may be thinned to 5 or 6 inches apart, crabs to 1 or 2 inches, large plums to 2 or 3 inches (fig. 18, *A* and *B*), and small plums and cherry-plum hybrids to about 1 inch apart. The thinner should not follow any definite rule for distance, as that will vary with the distribution of the fruit, but he should thin sufficiently to prevent breakage of branches or overbearing, which weakens the tree.

Generally grapes and other small fruits are not thinned.

CONTROL OF INSECTS AND DISEASES

Although insects and diseases are not so troublesome on the northern Great Plains as in most commercial fruit-growing regions, they cause considerable damage to both fruit trees and fruits. Every fruit grower should be prepared to combat them.

In handling, mixing, and applying poisonous insecticides and fungicides, take special care not to inhale excessive quantities at any time. After working with them wash the hands or any exposed parts of the body thoroughly.

Containers in which these materials are kept or stored should be plainly labeled and placed under lock and key, or at least out of the reach of irresponsible persons, children, or animals. Any



Figure 18.—Branches of a large-fruited variety of plum (*A*) before the fruit was thinned and (*B*) after it was thinned.

unused portions of these poisonous preparations as well as the receptacles in which they have been mixed should be treated likewise.

Some form of arsenic, such as arsenate of lead, is commonly used to control insects which bite or chew the foliage or fruit. Codling moth (the insect responsible for wormy apples), caterpillars, and various beetles are examples of insects controlled by arsenical sprays. Plum gougers and plum curculios are two snout beetles, the larvae of which work inside the fruit and spoil it. The gouger, probably the worst plum pest of the northern Great Plains, passes the winter in the soil or under trash and starts to feed on the trees as soon as growth starts in the spring. Eggs are laid on the small fruits before the pits harden, and the larvae burrow into the fruit pits, where they pass the larvae and pupal stages, and finally work their way out of the fruits about the time they ripen. An early spray, applied just before the blossom buds open, is most effective in poisoning the adults before they lay eggs. However, both plum gougers and plum curculios are rather difficult to poison, and arsenate of lead has given only partial control. In tests by chemical companies and others, the newer sprays benzene hexachloride and chlordane have given decidedly more effective control of plum curculios than has arsenate of lead, and it is possible that one of these sprays will solve the problem of controlling plum gougers. The old method of placing a cloth under the plum tree at the time of full bloom and jarring or shaking the gougers and curculios onto it, where they can be destroyed, is still one of the most practical methods of control. Late-fall cultivation may destroy many of the hibernating adults in the soil.

Soft-bodied sucking insects, such as aphids, or plant lice, and young leafhoppers, cannot be poisoned but may be controlled by a contact spray such as nicotine sulfate. Mites, or red spiders, are often troublesome in dry seasons, and effective control is difficult. Sulfur sprays or dusts and some of the summer spray oils such as Verdol have been fairly effective at the Northern Great Plains Field Station.

Grasshoppers are one of the most troublesome pests and sometimes strip trees of all foliage and even of the tender bark. Poisoned-bran bait scattered in and around the orchard may be effective if it is spread in time and the grasshoppers are not too numerous. The formula for the bait follows:

Sodium fluosilicate or paris green.....	¼ pound.
Dry, flaky wheat bran.....	5 pounds (1 peck).
Water to moisten.....	3 to 4 quarts.

Mix thoroughly the poison and the dry bran. Then moisten the mixture with water until each flake of the bran has been wetted. Apply this bait on sunny mornings when the grasshoppers are on the ground. Scatter the bait lightly and evenly on the surface of the soil or around the trees. Repeat application, if necessary. In preliminary tests chlordane also has given good results in controlling grasshoppers.

Plum borers are especially destructive to Japanese hybrid plums, but they also attack other plums and Bessey cherries. They work under the bark, near the ground, and may girdle the tree. Sawdust-like castings near the base of the tree usually reveal their presence. Paradichlorobenzene has been used with success at the Northern Great Plains Field Station in the control of borers. About ¾ to 1 ounce



Figure 19.—Plum trunk damaged by borers, and a borer killed by paradichlorobenzene treatment.

of the crystals is scattered in a ring around the infested tree, about 2 inches from its base, and the soil is then hilled up several inches around the tree trunk. Care should be taken that the crystals do not come in direct contact with the trunk of the tree, and it is not considered safe to use paradichlorobenzene on trees less than 5 years of age. Figure 19 shows a plum borer after being killed by the paradichlorobenzene treatment. The damage wrought by the borers may be seen in this figure. Another treatment, recommended by some but not tried at the Northern Great Plains Field Station, consists in painting the bark in late fall, or before growth starts in the spring, with a compound consisting of 1 pound of paradichlorobenzene dissolved in 2 quarts of cottonseed oil.

Bordeaux mixture and lime-sulfur are used as sprays to control fungus diseases such as apple scab, brown rot of plums, plum pockets, certain cankers, leaf spots, blights, and wilts. To be effective in controlling plum pockets, the disease that causes the fruit to swell up to several times normal size, the fungicide should be applied at dormant strength (1 gallon of lime-sulfur to 9 gallons of water) before growth starts in the spring.

Fire blight, a bacterial disease working inside the bark of apples and pears, cannot be controlled by spraying. Blighted limbs or cankers may be cut out considerably below the visible evidence of the disease and the cut branches burned. The cut surface and tools should be disinfected. Black knot of plums and chokecherries is another disease controlled by cutting out and burning infected branches.

A disease thought to be the western X-disease (virus) sometimes attacks chokecherries in the area. Symptoms are small leaves of a

reddish color and dying of the trees often within a year or two after the disease becomes noticeable. Sometimes sand cherries and plums are infected with what is thought to be the same disease. Trees or bushes showing symptoms of this disease should be pulled out.

DDT, which acts both as a contact insecticide and a stomach poison, is effective in the control of many orchard insects, including codling moth, blister beetles, flea beetles, leafhoppers, and grasshoppers. When applied in the last stages of the blossom period and again 2 weeks later, DDT has been the most useful spray tested for the control of the currant fruitfly maggot of clove ("golden") currants. However, it does not control aphids, mites, or red spiders, and snout beetles, and its value in the orchard spraying schedule on the northern Great Plains has not been fully determined.

Fish-oil soap is of value as a spreader when mixed with arsenate of lead or nicotine sulfate sprays, but it should not be mixed with lime-sulfur.

In most years, three sprays have been sufficient to give satisfactory control for most insects and diseases common at Mandan. These consisted of a dormant spray applied shortly before growth started in the spring, a second spray soon after the petals fell, and a third in late June or early July.

The formula used for the dormant spray follows:

Arsenate of lead (powder)-----	2.5 pounds
Lime-sulfur concentrate (33° Baumé)-----	10 gallons
Water-----	100 gallons

The formula used for the second and third sprays follows:

Arsenate of lead (powder)-----	2 pounds
Lime-sulfur concentrate (33° Baumé)-----	3 gallons
Nicotine sulfate (40-percent)-----	12 fluid ounces
Water-----	100 gallons

Sometimes additional sprays or dusts are necessary to control mites, or red spiders, and other insects when they are unusually abundant.

As plums and apples require about the same schedules, it is generally practicable to spray them at the same time. Small fruits may be sprayed along with the apples and plums, or whenever currant worms, caterpillars, or aphids are noticed on the bushes. Young trees and bushes may not need spraying, but the farmer should be prepared to spray if insects start damaging the foliage.

A common horizontal type of barrel-pump sprayer, equipped with an agitator and 20 to 25 feet of hose, has been found convenient for the home fruit garden (fig. 20). A fairly high pressure, at least 100 pounds, is desirable. Care should be taken to cover thoroughly all parts of the plant with the spray. The sprayer should be washed out and cleaned after each spraying.

PROTECTION FROM RABBITS AND MICE⁷

It is probable that rabbits and mice, particularly the former, have killed a very large percentage of the apple and crab trees that have failed to survive on the northern Great Plains. Protection from these pests is even more important than spraying, at least for young trees.

⁷Revised by Branch of Predatory and Rodent Control, Fish and Wildlife Service, U. S. Department of the Interior.



Figure 20.—Spraying a young orchard with a barrel-pump sprayer.

If possible, the farm fruit garden should be enclosed by a rabbit-proof fence. If this is not practicable, it is advisable to wrap the trunk and larger branches of each tree with wood-veneer wrappers, heavy paper, burlap, cornstalks, or fine woven wire. This should be done before the first heavy snows of early winter, and the wrappers should remain on the trees until grass and other vegetation start to grow in the spring.

If the snow is not drifting, it sometimes pays to shovel it away from the trunks of the trees, so that the rabbits cannot reach the higher, unprotected branches.

Poisoning also keeps rabbits in check. Poisoned corn, oats, alfalfa, and salt have been used at the Northern Great Plains Field Station with fair success. Directions for preparing poisoned oats, as furnished by the Fish and Wildlife Service, are as follows:

Mix 1 tablespoonful of starch in one-half cupful of cold water and stir into 1 pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strychnine with 1 ounce of powdered bicarbonate of soda (baking soda) and stir with the starch to a smooth, creamy mass. Stir in 1 teacupful of table salt, apply the mixture to 12 quarts of good clean oats, and mix thoroughly to coat each kernel.

Twelve quarts of corn may be substituted for oats, if desired. The grain is distributed in small piles where rabbits feed.

Poisoned alfalfa leaves may also be used, under directions of the Fish and Wildlife Service, as follows:

Dissolve 1 ounce of strychnine sulfate in 2 gallons of hot water and sprinkle over 10 pounds of alfalfa hay leaves. Mix the leaves thoroughly until all moisture is absorbed.

The poisoned leaves may be distributed in small handfuls in rabbit paths leading to the orchard and in the orchard itself.

Poisoned salt is effective in some cases. About 1 ounce of strychnine is mixed with 20 ounces of common salt and moistened enough to pack into 1-inch holes drilled half way through a 2- by 4-inch block of wood. The blocks are distributed in places where the rabbits are likely to run.

In handling poisons, care should be taken that they are kept out of the reach of children and that livestock are not poisoned.

Persistent shooting is one of the most effective methods of keeping rabbits in check. Also, various substances have been used on the bark of trees to act as repellents to rabbits. Lime-sulfur applied at the rate of 1 gallon of concentrate and 1 pound of glue to 9 gallons of water has been used with some success. The Michigan Agricultural College has recommended rosin dissolved in ethyl alcohol as a repellent. Other repellents include blood, axle grease, sulfonated oils, asphalt, lard, and various preparations on the market. Such repellents may be more or less effective, the difficulty being that most of them wear off in a few weeks and leave the trees unprotected. Some of them, such as sulfonated oil, however, should not be used, because they may injure the trees under certain conditions. TP-96A, a new repellent obtained from the Fish and Wildlife Service, has given very good results in some districts, including the Northern Great Plains Field Station (a very limited test).

Meadow mice sometimes build nests in straw or other material put around the tree for winter protection and may gnaw the bark and girdle the tree. Experience at the Northern Great Plains Field Station indicates that if the mulch is applied late in the fall or early in the winter after the ground is frozen and the mice have found their winter quarters there is not likely to be any trouble. However, mulch material should not be grain or hay bundles that have not been threshed, as mice may be brought in with the bundles. If mice are present, the trees may be protected by wrappers of wood veneer or fine wire, and the mulch close to the trunk must be removed. Best protection is attained by poisoning the mice through use of zinc-phosphide or strychnine-treated apple and grain baits strategically placed in mouse runways or trails.⁸

Severe pruning may be necessary for trees that have been damaged by rabbits or mice. Girdled limbs should be removed, and if the trunk has been girdled it may be necessary to cut off the entire top of the tree. In that event sprouts come from near the ground and are trained to form a new top. If the bark is eaten on only one side of a limb, the rough edges may be cut away and the damaged part wrapped with some material to reduce drying out or the wound may be covered with grafting wax or other substance. Bridge grafting, which requires considerable skill, may be resorted to when the trunks of valuable trees have been girdled. The method consists in using live scions to bridge the girdled area, the ends of the scion being inserted under the healthy bark above and below where the damage took place.⁹

⁸ Detailed information on this subject is given in U. S. Department of the Interior Fish and Wildlife Bulletin 36, Control of Destructive Mice.

⁹ For full directions, see Farmers' Bulletin 1361, Bridge Grafting.

SPECIAL WINTER PROTECTION

Some fruit plants always require special winter protection on the northern Great Plains, and protection may also be desirable for other fruit plants during the first few winters after planting.

Strawberries should be covered with about 6 inches of clean straw just after the ground freezes. The straw may be removed in the spring after growth starts if clean cultivation is practiced, or it may be left as a mulch between the rows until after harvest. The latter method produces cleaner fruit and is effective if weeds do not become troublesome.

Raspberries and grapes, except the hardy native grape, should be completely covered with soil during the winter. They are covered just before the ground freezes in the fall, generally in late October, and are uncovered just before the buds start growth in the spring, generally about May 1. Care must be taken not to break the canes when they are bent over for covering. The canes are bent over and the tops held down with a shovelful of soil (fig. 21). The canes are then completely covered by shoveling soil on them. Some varieties of gooseberries, especially if growing in exposed locations, are benefited by being covered with soil.

The most difficult period with fruit trees is the first 2 years after planting. It often pays to give them special winter protection during this comparatively tender period. If the trunk and main branches are properly wrapped to prevent rabbit injury, such wrapping will also serve to lessen drying out and sunscald of the bark. A goodly number of cornstalks tied around each tree in late fall, with the tops



Figure 21.—Raspberry canes being bent over and tips held with soil in late fall. They are then completely covered to a depth of several inches.

sticking up through the branches, will help to protect the trees from both rabbits and wind.

The roots of young trees are often protected by piling soil, old manure, or partly rotted hay or straw around the trunks during the winter or by covering the entire fruit garden with 8 to 10 inches of straw or old hay. In either case the mulch is applied in late fall and removed before the trees start growth in early spring. The mulch aids in protecting the roots from winter injury but does not delay the time of bloom in the spring as many persons think it does. As before stated, care must be taken that mice do not build nests in the mulch and damage the trees.

Sometimes a board is driven into the ground near each tree to shade the southwest side of the trunk in the afternoons of winter and early spring and thus prevent sunscald. Whitewashing the trunk and larger limbs also lessens the danger from sunscald, as the white surface remains cooler in the sunshine than would the darker bark. The whitewash is applied in early December and again in early March, warm days being chosen so that the whitewash will dry before freezing.

It is even possible to lay young fruit trees down and entirely cover them with soil, but this involves considerable work if done carefully. If it is to be done, the trees should be planted in a slanting position to facilitate laying them down without breaking. It is doubtful whether this method will ever become common.

KINDS AND VARIETIES OF FRUITS

Fruit growing on the northern Great Plains is restricted to the most hardy kinds and varieties. Plants of such fruits as pears, peaches, apricots, quinces, cherries, and erect and trailing blackberries and nuts are not generally hardy in this area, and except for a few new promising introductions their planting cannot be advised. Apples, crabs, plums, plum hybrids, Bessey cherries, serviceberries (Juneberries), grapes, currants, gooseberries, raspberries, and strawberries can be grown with a greater or less degree of success, depending on the district, the varieties chosen, the moisture supply, protection from wind, and the care given. Seedlings of hardy native fruit plants, including plums, serviceberries, Bessey cherries, clove ("golden") currants, buffaloberries, and chokecherries, may be grown to advantage on the dry-land farm. Some of the native fruit trees and shrubs, such as plums, buffaloberries, and chokecherries, may be used as outside or inside rows of the windbreak planting and there serve the dual purpose of providing shelter and producing some fruit. If plum trees are used in the windbreak they should be sprayed, so as not to harbor insect pests.

Plant breeders have made a great deal of progress in introducing new, improved varieties of fruits adapted to conditions on the northern Great Plains. As a result, the present list of recommended varieties is decidedly superior to a corresponding list of even 10 years ago, and much further improvement may be expected in the future.

A long period of trial under many different conditions is required to determine definitely the merits of a new variety. It is best for the grower to plant most of his ground to those standard varieties that have proved their merits under varying conditions for a number of years. Some space may be given to the newer sorts that appear to be promising but lack extensive tests.

It is well to select varieties that will supply fresh fruit for the table over a comparatively long period in the summer and fall. By judicious selection fresh fruit can be picked almost continuously from the time strawberries begin to ripen in late June until the last apples are harvested in October, or for a period of almost 4 months of the year.

It is best to plant two or more varieties of each kind of fruit, as many varieties are self-sterile. In other words, pollen from some other variety of the same kind of fruit is required if flowers are to be effectively fertilized and fruit is to set. This explains why trees of a single variety so often bloom profusely but fail to set fruit. The two varieties must bloom at about the same time, so that bees and other insects will carry pollen back and forth from one variety to the other. This is of greater importance with apples, crabs, plums, plum hybrids, clove currants, and Bessey cherries in which self-sterility is the rule, than with gooseberries, currants, grapes, and raspberries, which are generally self-fertile.

It is obviously impossible to give a list of fruit plants best suited to all parts of the northern Great Plains, as it is possible to grow some fruits at low elevations in the eastern part that would not mature at the higher altitudes nearer the Rocky Mountains or, perhaps, in the extreme northern part of the area. It is desirable for the farmer to write to his State agricultural college and to seek the advice of any neighbors who have succeeded in growing fruit, in order to determine which varieties are the safest for him to plant.

APPLES AND CRAB APPLES

Apple and crab trees should form a considerable part of the home fruit garden in most sections of the northern Great Plains. However, protection from wind is very important as apples are often blown from the trees before they ripen. Rabbits and mice prefer the bark of apple trees to that of most other trees; therefore protection from rodents (p. 32) is essential. Fire blight is a very troublesome disease in some districts, particularly in seasons when the trees are making rapid growth. Sunscald is often severe on older trees after periods of drought. In general, crab trees are hardier and more prolific than apple trees and are less subject to damage by rabbits. Success in growing apples largely depends on giving the trees every possible protection and care.

Many apple and crab trees have failed to survive because of tender roots. The common French crab stock is not hardy enough for the northern Great Plains. Siberian crab (*Malus baccata*) seedlings have been most satisfactory as stock for apples and crabs at the Northern Great Plains Field Station. Seedlings of such hardy crabs as Florence and Dolgo may also be used for stocks, or hardy apple and crab varieties may be grown on their own roots.

Standard Varieties of Apples

The hardiest varieties of apples for the northern Great Plains are mostly of Russian origin. Brief comments on some standard varieties are given below. The varieties of apples are listed in order of ripening from the earliest to the latest.

Yellow Transparent.—This Russian apple is of value because of its earliness. The fruit generally ripens about the middle of August and is medium in size to

large, pale yellow, roundish-conic, good for culinary uses, and fair for dessert. The fruit bruises easily and does not keep long. The tree is fairly hardy and productive, but somewhat subject to damage from fire blight. Yellow Transparent is of value in sections having short growing seasons.

Charlamoff.—This Russian variety has been outstanding in some parts of the northern Great Plains and has failed in other parts. It has a good record in parts of Canada. Charlamoff ripens a little after Yellow Transparent. The fruit is medium in size to large, striped with red, tart, and acceptable for dessert or culinary uses; but it does not keep long. The tree is fairly hardy and prolific.

Mantet.—This early variety of Canadian origin is a seedling of the Russian variety Tetofsky. It is considered one of the best of the early apples and usually ripens after the middle of August. The fruit is medium in size to large, roundish, striped with red, pleasantly subacid, and of good quality for dessert and culinary purposes. The tree has been hardy and productive at Mandan.

Melba.—Melba, also of Canadian origin, ripens after the middle of August, at about the same time as Mantet. The fruit is medium in size to large, attractively striped with red, roundish, and of good quality for dessert and culinary uses. While not quite so hardy as Oldenburg, the tree has been productive at Mandan and is considered worthy of planting in the more favorable sections of the northern Great Plains.

Anoka.—Anoka has the unusual quality of bearing fruit from lateral buds on 1-year-old wood as well as on spurs, and it comes into bearing at an earlier age than most other varieties. The fruit generally ripens after the middle of August. While striped with red, the medium-sized, roundish-conic fruit is not so well-colored or of as good quality as Oldenburg. It does not keep long. The tree (fig. 22) is fairly hardy and very prolific, but it is not considered very long-lived.



Figure 22.—Young Anoka apple tree, bearing fruit, at the Northern Great Plains Field Station.

Oldenburg.—This apple, commonly known in the Northwest as Duchess, is one of the most widely planted of the Russian varieties. The fruit usually ripens in the latter part of August and is medium in size to large, striped with red, roundish-oblate, pleasantly subacid, fair for dessert, and good for culinary uses; but it keeps poorly. The tree comes into bearing at an early age and is hardy and productive for an apple. Oldenburg should be included in home fruit gardens wherever apples are grown on the northern Great Plains. A variety known as Red Duchess originated as a bud sport of the Oldenburg. It is similar to the latter, but more attractive in color.

Erickson.—Erickson originated in Minnesota and is probably of Russian parentage. The fruit ripens in the latter part of August, the season being about the same as that of Oldenburg. It is large, striped with red, roundish-oblate, often ridged, tart to subacid, fair for dessert, and good for culinary uses. The tree is vigorous, fairly hardy, and moderately productive.

Beacon.—Beacon, an introduction from Minnesota, generally ripens about the first of September. The fruit is medium in size, of an attractive red color, oblate, and of good quality, especially for eating out of hand. The tree has been fairly hardy at Mandan, but not very prolific. Beacon is worthy of trial in more favorable sections of the area.

Mortof.—Mortof, a Canadian introduction, generally ripens in early September. The fruit is medium in size to large, greenish yellow washed with red, oblong-conic, pleasantly subacid, and of good quality for dessert and culinary uses. The tree has been fairly hardy and productive at Mandan.

Wealthy.—Wealthy, a seedling of Cherry crab, originated in Minnesota and is one of the best dessert apples that can be grown on the northern Great Plains, though it is not so hardy as some of the Russian varieties. The fruit generally ripens about the middle of September and is medium in size to large, striped and splashed with red, roundish-conic, juicy, pleasantly subacid, and good for dessert and culinary uses. It keeps better than Oldenburg. The tree is not so hardy as could be wished, but it fruits at a fairly early age and is generally productive. Wealthy is recommended only for the more favorable sections of the area.

Hibernal.—This Russian variety is perhaps the hardest apple. The fruit generally ripens about the middle of September and is large, striped with red (often only on one side), oblate-conic, and too sour for dessert, but fair for culinary uses. The tree will grow if apples will grow at all, is generally productive, and makes an unusually strong framework suitable for top working other varieties (fig. 23).

Patten.—Patten, a seedling of Oldenburg, originated in Iowa and resembles its parent in some fruit and tree characteristics. The fruit generally ripens in the middle of September and is medium in size to large, green in color, oblate, subacid, fair for dessert, and good for culinary uses. The tree is one of the hardest of the apples and is generally productive.

Longfield.—This Russian variety generally ripens in the latter part of September. The fruit is below medium in size, pale yellow blushed with red, roundish-conic, and good for dessert and culinary uses. Its keeping quality is only fair. The tree is fairly hardy and prolific.

Wedge.—This late apple is medium in size to large, red, roundish-conic, and tart, keeps fairly well, and is of good quality for dessert and culinary uses. The tree is a vigorous grower and is hardy and moderately productive.

Haralson.—Haralson generally ripens in the latter part of September. The fruit is medium in size to large on young trees, but sometimes below medium in size on older trees that tend to overbear. The apples are firm, roundish-oval, striped with red, and of good quality for dessert and culinary uses. Keeping quality is very good, the apples lasting well after the first of the year if stored in a cool place. The tree is a moderately vigorous grower, is prolific, and ranks among the hardest for the area. These qualities make Haralson one of the most useful varieties for the northern Great Plains.

Goodhue.—Goodhue generally ripens in the latter part of September. The fruit is medium in size to large, red, oblong-conic, firm, and tart, keeps well, and is of good quality for dessert and culinary uses. The tree is fairly hardy and moderately productive.

Other Varieties.—Antonovka, Okabena, and Anisette are three other varieties that have done fairly well at Mandan or elsewhere on the northern Great Plains. Breakey, Yeager Sweet, Waukon, Prairie Spy, Victory, Jethro, Hicks, Horace, Winton, Minjon, and Mandan 27-7 are newer varieties considered worthy of trial.



Figure 23.—Harvesting Hibernial apples at the Northern Great Plains Field Station.

Standard Varieties of Crab Apples

There are many good varieties of crab apples that are reasonably hardy and productive on the northern Great Plains. Those here described are listed in their order of ripening.

Silvia.—Silvia ripens in early August. Because it is one of the earliest of all crabs under test it should be of value in sections having the shortest growing seasons. The fruit is medium size, yellow, oblong, and of fair quality if picked when a little green; but it becomes mealy if too ripe. Silvia is good for pickles and jelly, but it is a poor keeper. The tree is hardy, upright, and productive.

White Arctic.—This variety generally ripens a little after the middle of August. The fruit is medium in size, of a pale-cream color, roundish, firm, juicy, subacid, and useful for jelly and pickles. The light-colored skin is easily bruised when not handled carefully. The tree is fairly hardy and very productive. It should be valuable in sections having short growing seasons.

Rosilda.—Rosilda generally ripens from the middle to the latter part of August. The fruit is large, of an attractive red color, roundish-oval, and of good quality for culinary uses and fair for dessert. The tree has been fairly hardy and prolific. This variety is considered one of the best crabs for the more favorable sections of the northern Great Plains.

Sweet Russet.—This crab ripens from the middle to the end of August. The fruit is large, greenish yellow marked with russet, oblong, sweet, and good for eating out of hand and culinary uses. The tree is fairly hardy and prolific.

Elsa.—Elsa generally ripens in the latter part of August. The fruit is small, of an attractive yellow color, oblate, firm, tart, juicy, and good for jelly. The tree is hardy and productive. Elsa is recommended for sections having severe weather and for those having short growing seasons.

Whitney.—Whitney generally ripens in late August. The fruit is very large for a crab, light yellow, shaded and striped with red, roundish-conic, pleasantly subacid, and very good for dessert and culinary uses. The tree (fig. 24) is upright, fairly hardy, and moderately prolific. Whitney is one of the best crabs for the more favorable sections of the area.

Florence.—Florence generally ripens in the latter part of August. The fruit is medium in size, striped and splashed with bright red, oblate, tart, subacid, and somewhat astringent, but good for culinary uses. It becomes mealy if too ripe. The tree (fig. 25) starts to bear at an early age and is spreading, hardy, prolific, and resistant to fire blight. Florence is highly recommended for the home fruit garden in all sections of the northern Great Plains.

Dolgo.—Dolgo ripens in the latter part of August. The fruit is small, oblong or oval, of an attractive bright-red color, juicy, tart, and excellent for making jelly. The tree is upright, hardy, and prolific. Dolgo is considered one of the most valuable varieties for the northern Great Plains.

Alexis.—The Alexis crab is very similar to Dolgo, and what has been said about Dolgo applies to Alexis.

Amur.—Amur generally ripens in late August or early September. The fruit is small, slightly oblate, of an attractive bright-red color, firm, juicy, tart, and excellent for jelly. The tree is upright, vigorous, resistant to fire blight, very hardy, and generally productive.

Trail.—This Canadian variety generally ripens in early September. The fruit is medium in size, yellow partly covered with red stripes, roundish, firm, juicy, subacid to sweet, very good for pickles and jelly, and also pleasant for eating out of hand. The tree is fairly hardy and productive. Trail is one of the better crabs.

Transcendent.—Transcendent generally ripens in early September. The fruit is medium in size, of attractive yellow and red colors when ripe, roundish, subacid, and somewhat astringent, but good for culinary uses. The tree is usually thrifty, hardy, and productive on the northern Great Plains. The worst fault of Transcendent is its susceptibility to fire blight; for this reason its planting cannot be recommended in districts where fire blight is known to be troublesome.

Printosh.—Printosh is a Canadian variety that ripens about the middle of September. The fruit is medium in size, striped with red, oval to slightly conic, firm, juicy, subacid, and of very good quality. The tree is hardy and prolific.

Robin.—Robin is a Canadian variety that ripens about the middle of September. The fruit is medium in size, yellow with a slight red blush, roundish, distinctly ribbed, firm, juicy, subacid, and desirable for jelly and pickles. The tree is spreading, hardy, and prolific. Robin is considered a very good variety for general planting.

Latham.—Latham ripens about the middle of September. The fruit is medium in size to large for a crab, striped with red, oblate, subacid to mildly sweet, firm, juicy, and good for dessert and culinary uses. The tree is fairly hardy and prolific.

Olga.—Olga generally ripens about the middle of September. The fruit is small to medium in size, of an attractive bright-red color, firm, juicy, tart, and very good for jelly. The tree is hardy and prolific.

Scugog.—This crab also ripens about the middle of September. The fruit is medium in size to large for a crab, oblong-conic, dark red with light red flesh, firm, juicy, slightly tart, and of good quality for culinary uses. The tree has not been tested long enough at Mandan to determine fully its hardness and productiveness, but Scugog is considered worthy of trial in the more favorable sections for those who wish to grow a red-fleshed variety.

Strawberry.—This crab ripens about the middle of September. The fruit is medium in size, attractively striped with bright red, roundish-oblate, firm, juicy, slightly tart, and of good quality for culinary uses. The tree is fairly hardy and productive.

Red River.—Red River is a cross between Dolgo and Delicious introduced by the North Dakota Agricultural Experiment Station. It ripens about the middle of September or a little later. The fruit is medium in size, of an attractive red color, roundish, firm, juicy, subacid, pleasant to eat out of hand, and good for culinary uses. The tree has not been tested long enough at Mandan to fully determine its hardness, but it is thought to be worthy of trial at least in the more favorable sections of the area.



Figure 24.—Row of Virginia crab trees at left and of Whitney crab trees at right, showing the greater vigor and more prolific bloom of the Virginia, at the Northern Great Plains Field Station.

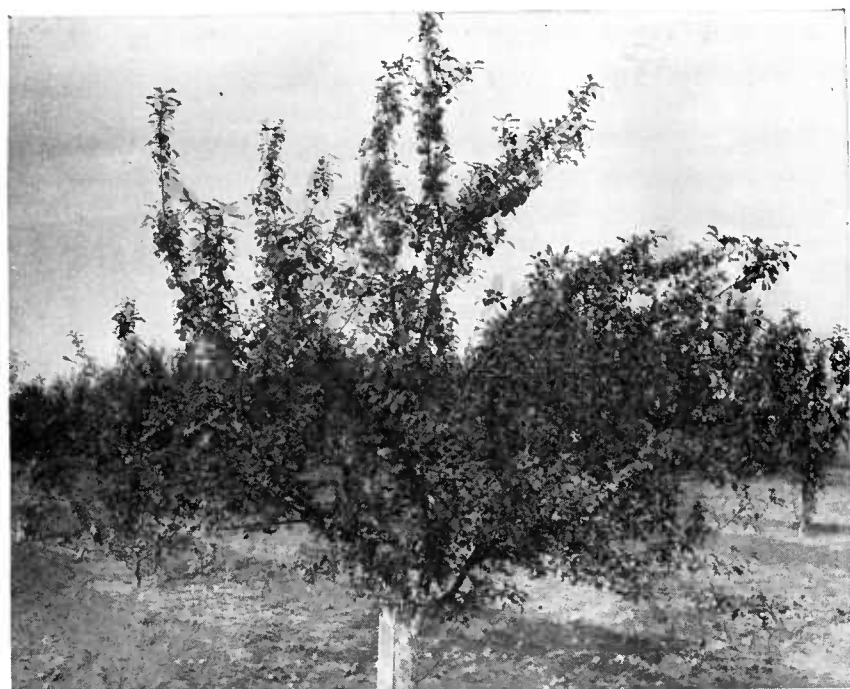


Figure 25.—Florence crab tree bearing fruit. This variety has been one of the most prolific of all varieties under test.

Ivan.—Ivan generally ripens about the middle of September or a little later. The fruit is medium in size, greenish, lightly splashed with red, roundish, firm, juicy, subacid, pleasant for dessert, and good for culinary uses. The tree is fairly hardy and productive.

Columbia.—This Canadian introduction matures about the middle of September or a little later. The fruit is small to medium in size, red when ripe, roundish-conic, firm, tart, juicy, and good for culinary uses, especially jelly. The tree is vigorous, hardy, and productive.

Hyslop.—Hyslop generally ripens from the middle to the end of September. The fruit is medium in size, of a very attractive dark-red color, roundish-oval, firm, tart, juicy, and of good quality for culinary purposes. The tree is fairly hardy and prolific. The worst fault of Hyslop is its susceptibility to fire blight; therefore it should not be planted in districts where this disease is known to be troublesome.

Lyman.—Lyman generally ripens from the middle to the end of September. The fruit is medium in size, striped with red, roundish, firm, juicy, slightly tart, and good for culinary uses. The tree is fairly hardy and moderately productive.

Virginia.—This variety, ripening in the latter part of September, is a little late for some sections of the northern Great Plains. The fruit is medium in size to large for a crab, blushed and striped with red on greenish yellow, roundish, pleasantly subacid, good for pickles and other culinary uses, and pleasant to eat out of hand. The tree (fig. 24) is vigorous, hardier than most varieties, and productive. The strong branches and framework make this variety desirable for top working.

Other Varieties.—Other varieties worthy of trial include Flame, Chestnut, Rescue, Bedford, Osman, Mandan selections 35-7 and 41-9, Kinsmere, Geneva, Dauphin, and Red Flesh. The last four have red or partly red flesh.

PLUMS AND THEIR HYBRIDS

Plums, plum hybrids, and cherry-plum hybrids are the most reliable fruit trees for the northern Great Plains and should form a considerable part of the home fruit garden. Varieties may be selected that will extend the harvest season from the time Opata and Tecumseh ripen—generally before the middle of August at Mandan—until Emerald is picked, generally in the latter part of September. The season is shorter in districts having shorter frost-free periods.

Hardy seedlings of native plum are thought to make the best stocks for plums in this area. Sand cherry (*Prunus pumila*) and Bessey cherry (*P. besseyi*) seedlings also have been used successfully as hardy stocks for plums, but the Bessey cherry roots sucker badly, the trees are likely to become top-heavy and blow over, and there is some evidence that these roots may result in a shorter lived tree. On the other hand, there is no difficulty in determining whether shoots are from the root or the scion, as the foliage of sand cherries is very different from that of the plum. The Bessey cherry root does well in sandy soils.

Plums recommended for the northern Great Plains may be divided into three general groups: namely, native plums (mostly *Prunus americana* or *P. nigra* selections), hybrids between native and Japanese (*P. salicina*) plums, and hybrids between either native or Japanese plums and the native Bessey cherries (*P. besseyi*).

Native Plums

Varieties of native plums have long been considered the most reliable fruit tree for the plains and prairies of both the United States and Canada. As a group they possess unusual hardiness and drought resistance for fruit trees, they are prolific bearers, and the fruit is acceptable for dessert and culinary uses. They are not, however, first-class for either purpose, as they are characterized by a tough, sour

skin and considerable sourness near the pit, especially when cooked. A few native plums should be included in every home orchard because of their hardness and fruitfulness and also because they generally furnish an abundance of pollen for cross-pollination, whereas the hybrids are often deficient in pollen production.

Standard varieties of native plums that have been grown successfully at the Northern Great Plains Field Station are listed in their order of ripening. As with apples and crabs, the time of ripening will vary to some extent in different parts of the northern Great Plains. Also, the time of ripening given represents an average. The ripening date of a variety may range from 2 weeks before to 2 weeks after the time given.

Bounty.—This early variety of *Prunus nigra* ripens about the middle of August, making it especially valuable for those districts in the northern Great Plains having the shortest growing seasons. The fruit is large, red, oblong, sweet, juicy, and of good quality for a native plum. The tree is upright, hardy, and prolific.

Assiniboin.—Assiniboin is also an early variety of *Prunus nigra* and generally ripens in late August. The fruit is large, red, oval, sweet, and of good quality for a native plum. The tree is upright, not very vigorous, hardy, and moderately productive.

Chilcott.—This plum ripens in late August, being one of the earliest of the *Prunus americana* varieties. It was selected from a block of seedlings of native plum at the Northern Great Plains Field Station in 1926 and named in 1947. The fruit is large, red, oval, sweet, and of good quality for a native plum. The tree is fairly upright, hardy, and productive.

Cheney.—Cheney, an old variety of *Prunus nigra*, generally ripens in late August or early September. The fruit is medium in size, red, oval, juicy, and of fair quality. The tree is upright, hardy, and productive. While Cheney has some value in the northern and western parts of the area, better varieties are available for most districts of the northern Great Plains.

Wolf.—Wolf ripens in late August or early September. The fruit is medium in size, dull red, roundish-oval, freestone, and of good quality for a native plum. The tree is vigorous, fairly hardy, and productive. The variety is one of the best of the old standard ones.

Manet.—This variety of *Prunus americana* ripens about the first of September. It was selected from a block of native seedlings at the Northern Great Plains Field Station in 1924 and named in 1947. The fruit is large, of an attractive red color, oval, sweet, juicy, medium firm, and of good quality for a native plum. The tree is spreading, hardy, and productive. It is one of the best varieties of native plum under test.

Terry.—Terry generally ripens in early September. The fruit is very large for a native plum, of attractive red and yellow colors, oval, firm-fleshed, clingstone, and of good quality for its group. The tree is fairly hardy and prolific, but somewhat subject to aphid attack. Because of the size and quality of the fruit, Terry is considered one of the best varieties of *Prunus americana*.

Wastesa.—Wastesa generally ripens in the first part of September. The fruit is medium in size to large, mottled red, roundish-oval, juicy, sweet, and of good quality. The tree is hardy and prolific.

Teton.—Teton ripens about the middle of September or a little earlier. The fruit is medium to large in size, red, oval, sweet, juicy, clingstone, and of fair to good quality. Sometimes the fruit drops badly when ripe. The tree is vigorous, very hardy, and prolific, but it is thorny and the branches have some tendency to split.

Wyant.—Wyant ripens about the middle of September. The fruit is medium in size, oblong-obovate, oblique, blotched red and yellow, nearly freestone, sweet, and of fair to good quality. The tree is one of the hardiest of its class and a prolific annual bearer and produces an abundance of pollen for cross-pollination. These qualities make Wyant valuable for the home fruit garden except in districts where earlier ripening varieties are needed. The tree, however, is spreading and thorny.

Desoto.—Desoto usually ripens about the middle of September. The fruit is small to medium in size, of attractive light-red and yellow colors, roundish-oval, and fairly firm and ranks high in quality among *Prunus americana* varieties. The tree is not so thorny as many other native plums, fairly hardy, and very productive, sometimes tending to overbear and thus weaken the tree.

South Dakota.—This variety ripens in late September. The fruit is large, part red, fairly firm, oval, sweet, and of good quality. The tree is hardy and productive and is a good pollinizer for other plum varieties. South Dakota ripens a little late for districts having short growing seasons.

The following two selections of *Prunus americana* have not yet been named, but tests indicate that they are worthy of trial in the home fruit garden.

Mandan Selection 45-3.—This seedling of Emerald ripens in late August. The fruit is medium in size to large, oval, purplish red, sweet, juicy, of pleasant flavor, and of good quality for a native plum. The tree is vigorous, hardy, and productive.

Minnesota 89.—While this plum is said to be of hybrid origin, both fruit and tree characteristics closely resemble those of the native *Prunus americana*. The fruit ripens in early September and is large, mottled red, clingstone, oval, sweet, juicy, and of better quality than the fruits of most other native plums. The tree is vigorous, hardy, and moderately productive.

Japanese Hybrid Plums

Of late years Japanese hybrid plums have largely replaced varieties of native plum in the nursery trade of the Northwest. The reasons are their large size, comparatively small pit, attractive appearance, and superior quality as compared with native varieties. However native × Japanese plums are not generally so hardy or prolific as native varieties, nor do most of them produce much pollen. For these reasons it would seem best not to discard the native varieties, but to grow some of each class in the home garden. A few hybrids between native plums and the apricot plum of China (*Prunus simoni*) are also included with this group as they have many of the same characteristics.

Some of the better Japanese hybrid plums are briefly described in their order of ripening.

Tecumseh.—This plum, which ripens in early August, is among the earliest under test. The fruit is of large size; has an attractive red color and thin skin; and is firm, sweet, juicy, and good for dessert and culinary uses. The tree is moderately hardy and generally productive. Tecumseh is considered a very valuable variety for the northern Great Plains.

Radisson.—This fine early plum generally ripens about the middle of August. The fruit is large, oval, of an attractive red color with tan-colored dots, sweet, firm, juicy, and of excellent quality. Radisson blooms early, thus being subject to injury from late-spring frosts. The tree is moderately hardy, but average yields are not so large as those of many other varieties.

Pembina.—Pembina also matures about the middle of August. The fruit is large, deep red, roundish, firm, sweet, and of superior quality. The tree is fairly hardy; but because it blooms early, yields are reduced by spring-frost damage in some years. Pembina seems to thrive best toward the northern part of the area and in districts requiring an early-maturing variety.

Cree.—Cree is one of the hardest and most prolific of the Japanese hybrids. The average ripening date is about August 15 or a little later. The fruit is medium in size, red, oval, clingstone, sweet, juicy, thick-skinned, and of fair quality. This variety approaches nearer to the native type than most other Japanese hybrids. It is of value in some districts because of its earliness, hardness, and productiveness, but it has little or no advantage over the better varieties of native plum.

Underwood.—Underwood ripens about the middle of August. The fruit is large, oval to slightly cordate, of an attractive red color, sweet, juicy, thin-skinned, and of good quality. The flesh is a little soft when fully ripe; therefore this plum does not keep long. The tree is vigorous, fairly hardy, and moderately productive. As the variety does not tend to overbear, old trees continue to produce fruit of large size. This variety rates as one of the better Japanese hybrids for the home fruit garden.

La Crescent.—La Crescent ripens about the same time as Underwood. The fruit is small to medium in size, yellow with a light red blush, roundish, thin-

skinned, very sweet, and excellent for dessert or culinary uses. The flesh is too soft for the fruit to keep very long. The tree is vigorous, but on the border line as regards hardiness and somewhat erratic as a yielder. Because of its quality, La Crescent is recommended for the more favorable districts of the northern Great Plains.

Grenville.—Grenville generally ripens from the middle to the latter part of August. The fruit is very large, mottled red and yellow, roundish, firm, sweet, and of good quality. Young trees have been hardy and prolific at Mandan. However, this variety has not been tested long enough to determine whether the trees are long-lived under northern Great Plains conditions. Grenville is deemed worthy of trial because it may be one of the better plums that can be grown in favorable districts.

Fiebing.—This variety also ripens from the middle to the latter part of August. The fruit is large, of an attractive red color, firm, roundish-oval, and of good quality. While somewhat subject to brown rot in districts of higher rainfall, the fruit has had but little trouble with this disease at Mandan. The tree has been fairly hardy and very productive.

Red Coat.—Red Coat generally ripens in the latter part of August. The fruit is large, of an attractive red color, long, slightly cordate, sweet, fairly firm, free-stone, and of very good quality. The tree has been fairly hardy and prolific. This variety is replacing Red Wing because the fruit is more resistant to brown rot and the tree appears to be hardier and longer lived. Red Coat is considered to be one of the best Japanese hybrid plums for general planting in the northern Great Plains.

Tokata.—Tokata ripens in the latter part of August. The fruit is large to very large, slightly cordate, of a mottled orange-red color, very firm, and of excellent quality for dessert and culinary uses. Like Hanska and Kaga, it inherits from one parent the rich flavor of the apricot plum (*Prunus simoni*). The tree is semihardy and not very productive. Tokata is recommended only for the more favorable districts of the northern Great Plains.

Ojibwa.—Ojibwa generally ripens in the latter part of August or sometimes in the early part of September. The fruit is medium in size and oblong and becomes bright red some time before it ripens. The firm flesh, thin skin, and pleasantly tart flavor make it excellent for culinary uses. The tree is moderately hardy and very productive.

Redglow.—Redglow ripens in late August or early September. The fruit is large, roundish, of an attractive red color, firm, sweet, and excellent for dessert and canning. The tree is fairly hardy and productive. This variety is recommended for planting in the more favorable districts of the northern Great Plains.

Waneta.—Waneta generally ripens in early September. The fruit is large to very large, deep red, somewhat cordate, clingstone, firm, slightly tart, and of fair quality for dessert and good for culinary uses. The tree is spreading, harder than most other Japanese hybrid plums, and very productive. It sometimes tends to overbear. Waneta is a valuable variety for the northern Great Plains.

Hanska and Kaga.—The fruits of these varieties are very much alike, both ripening in early September and being medium in size, red, roundish, very firm-fleshed, and delightfully flavored by the apricot plum (*Prunus simoni*), one of the parents. Being very firm, the fruits keep better than most other plums. The trees have not been entirely hardy or drought-resistant at Mandan, but have been fairly productive in most years. Hanska trees are more vigorous and upright than the spreading ones of Kaga. Otherwise there is little to choose between the two. Kaga is often recommended as being a good pollinizer for other varieties. Both have value on the northern Great Plains, especially in the more favorable districts.

Elliot.—Elliot generally ripens from the first to the middle of September. The fruit is large, of a mottled red color, slightly cordate, and very firm, keeps well, and is especially desirable for culinary uses. The tree is spreading, one of the hardiest of the Japanese hybrids, and a heavy yielder. This variety is recommended as a good late plum in districts where it will ripen before frost.

Ember.—Ember also ripens from the first to the middle of September, making it a little late for much of the northern Great Plains. The fruit is large to very large, roundish-oval to slightly cordate, of an attractive red color, firm-fleshed, sweet, and of very good quality for dessert and canning. It clings firmly to the tree if not too ripe and keeps well after picking. While not entirely hardy, the tree is moderately productive. It is recommended for sheltered sites in the southern and eastern parts of the northern Great Plains.

Monitor.—Monitor generally ripens from the middle to the last of September. The fruit is large to very large, of a mottled, red dark color, with conspicuous russet dots, roundish-oval, clingstone, sweet except for a little tartness in skin and near pit, juicy, medium firm, and good for dessert and culinary uses. The tree is moderately hardy and prolific. Monitor is also recommended for sheltered sites in districts having the longest frost-free period.

Emerald, Burwood, Omaha, and Winona.—These varieties all ripen in the latter part of September, making them too late to mature their fruits on much of the northern Great Plains. The fruits are large, of dull mottled red and yellow colors, very sweet and juicy, and suitable for dessert and culinary uses. They are not good keepers. The trees have ranked among the hardiest of the Japanese hybrids, and they have been productive as a general rule. They are recommended for parts of the northern Great Plains having the longest growing season.

Other Varieties.—Other Japanese hybrid varieties worthy of trial include Toka for all districts and Pipestone, Superior, Hennepin, and Splendid for the more favorable districts of the northern Great Plains. The last four produce large plums of good quality, but the trees have not been entirely hardy at Mandan.

Cherry-Plum Hybrids

Crosses between plums and Bessey cherries (cherry-plum hybrids) have resulted in several varieties that are of decided value on the northern Great Plains. The trees tend to bear at an early age, are generally prolific, hold the fruit firmly, so that it is not easily blown off, and bloom late, thus tending to escape late-spring frosts. They generally ripen their fruit early in the season, are drought-resistant, and suffer very little from attacks of aphids. These hybrids are generally superior to native plums for culinary uses, as they have a tenderer skin, a smaller pit, and considerable less of the objectionable sourness of native plums when cooked. Some varieties come nearer to taking the place of the cherry than anything else at present in the nursery trade.

Objections to this cherry-plum hybrid group are that the trees tend to be short-lived and sometimes produce but little pollen and that the fruit is usually of small size and as a rule keeps poorly. Trees in this group should be grown in bush form only (fig. 26).

Standard varieties of cherry-plum hybrids are briefly described in their order of ripening.



Figure 26.—Part of the plum-variety-testing orchard at the Northern Great Plains Field Station, showing the characteristic bush form of cherry-plum hybrids.

Oka.—Oka ripens in early August. The fruit is small to medium in size, dark-purple-skinned, red-fleshed, roundish, small-pitted, sweet, juicy, soft, and of good quality, but it keeps poorly. The tree is not so hardy or prolific as that of Opata. The variety is recommended for the more favorable districts of the area.

Opata.—Opata generally ripens in early August. The fruit is small to medium in size, dark-purple-skinned, green-fleshed, roundish, small-pitted, clingstone, medium sweet, juicy, soft, of fair dessert quality, and good for culinary purposes. The tree (fig. 27) is drought-resistant, fairly hardy, and very prolific, often tending to overbear. Opata is recommended for all parts of the area.

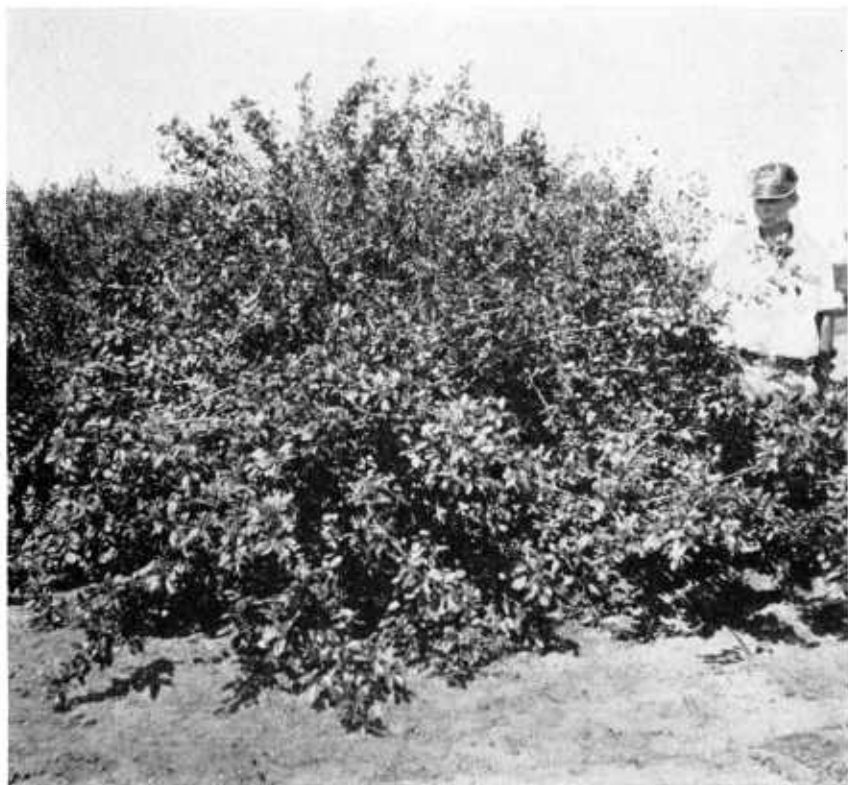


Figure 27.—Opata cherry-plum hybrid growing in bush form at the Northern Great Plains Field Station. This variety is one of the most valuable for the northern Great Plains.

Sapa.—Sapa ripens from the middle to the latter part of August, generally about 9 or 10 days after Opata. The fruit is of about the same size, shape, and skin color as that of Opata, but it has firmer flesh, which is dark red or black, and is of very good quality. It is especially valuable for culinary uses, making excellent jam and taking the place of the cherry in pies and sauce. The tree is not so hardy as that of Opata or so reliable a bearer; but, because of the superior quality of the fruit, Sapa is recommended for the more favorable districts and well-protected sites (fig. 28).

Compass.—Compass usually ripens in late August. The fruit is small, red and yellow, oval, clingstone, and of only fair dessert quality, but good for culinary uses. Compass will probably stand up and bear fruit under as severe conditions as any other variety. The tree is very hardy, drought-resistant, and generally a heavy annual bearer. A few trees of this variety should always be included in the home fruit garden (fig. 29).



Figure 28.—Winterkilled Sapa cherry-plum hybrid (foreground) and uninjured Opata cherry-plum hybrid (row at left).



Figure 29.—Compass, one of the hardiest and most prolific of the cherry-plum hybrids.

Zumbra.—Zumbra ripens about the same time as Compass. The fruit is small to medium in size, dark-purple-skinned, green-fleshed, sweet, and especially good for culinary uses. The tree is fairly hardy, but not a heavy yielder. It is recommended for trial in the more favorable districts.

Other Varieties.—Dura, Manor, Sapalta, and Mordena are newer varieties of cherry-plum hybrids introduced by experiment stations in Canada. The first three are seedlings of Sapa and have the high quality and dark-red or black flesh of the female parent. They also have the dark-purple skin color of Sapa except for Dura, the skin of which appears to be a mottled olive green. These seedlings of Sapa have not been tested long enough to fully determine their hardiness; but if any one proves to be definitely hardier than Sapa, it should find an important place in home fruit gardens. All three are worthy of trial. Mordena bears smaller fruits which are green-fleshed and not so high in quality as fruits from the three Sapa seedlings. The tree of Mordena appears to be more vigorous than the others and hardier, however, and this variety will probably thrive over a wider territory.

CHERRIES

None of the common varieties of cherries in the nursery trade is hardy enough for general planting on the northern Great Plains. In unusually well protected sites in the most favorable districts success is occasionally obtained with such varieties of sour cherry (*Prunus cerasus*) as Early Richmond, Dyehouse, Bessarabian, or Wragg, but cherries cannot be generally recommended for this area.

Selection of the Manchu (Nanking) cherry (*Prunus tomentosa*) and of hardy Russian cherries from the Vladimir district appear very promising as hardy cherries for the future, but few named varieties are on the market at present.

The Dominion Experiment Station, Morden, Manitoba, introduced Drilea, a variety of the Manchu cherry, and Coronation, a Shubianka sour cherry seedling. Both are deemed worthy of trial in sheltered locations. A Mandan selection of the Manchu cherry, No. 39-3, is one of the best in quality, but it has not been entirely hardy. Several numbered selections of the Manchu cherry introduced by the Minnesota State Fruit Breeding Farm at Excelsior, Minn., are worthy of trial; one of these recently was named Orient. That institution has also introduced several selections of the Chinese, or Korean, bushberry (*P. japonica*). These are not so drought-resistant as the Manchu cherry, but they are suitable for pies and sauce and may be tried in more favorable districts.

APRICOTS

Plant breeders have made considerable progress in developing hardy apricots. The South Dakota Agricultural Experiment Station has named several seedlings of the Manchurian apricot (*Prunus mandshurica*), and the Dominion Experiment Station, Morden, Manitoba, has introduced the Scout apricot. The Siberian apricot (*P. sibirica*) has also been crossed with standard varieties at the North Dakota Agricultural Experiment Station and the Northern Great Plains Field Station. Some of these introductions are thought to be worthy of trial in sheltered locations, as they are drought-resistant and reasonably hardy. The best apricots that have fruited at Mandan are Manchu, Ninguta, Scout, and Mandan selection No. 41-3. They should be propagated on Manchurian or Siberian apricot roots, as the apricot does not form a good union with the plum.

PEARS

Pears have not been fruitful at the Northern Great Plains Field Station, but some of the hardier varieties have survived without severe winter injury. They bloomed heavily in 1946 and 1947, but the blossoms were killed by frost. A light crop was produced in 1948. The planting of pears is not recommended as a general rule, but Patten No. 5, Bantam, Parker, Mendel, Chang, and Tait-Dropmore, which have been among the hardier varieties tested, are suggested for those who wish to try a few trees. The last-named variety is said to do well in parts of Manitoba.

SMALL FRUITS

Grapes

Most standard varieties of grapes lack the hardiness to thrive on the northern Great Plains. A few varieties, however, do well in the more favorable districts, especially if laid down and covered with soil during the winter. Such protection has more than doubled the yields of grapes at the Northern Great Plains Field Station.

Beta is the standard variety for the area and will thrive if any variety will. The fruit is smaller and more tart than that of Concord, but very acceptable for jelly and other culinary uses. Alpha, Suelter, and Dakota, which are similar to Beta, have done fairly well at Mandan, Suelter appearing to be hardier than the others in some years. Monitor ripens earlier than Beta, but has not been so prolific.

Several newer varieties have been introduced by the Minnesota and South Dakota Agricultural Experiment Stations; some of those are superior in size and quality to Beta. However, these better varieties, as a general rule, have been less hardy and less productive than Beta.

Native grapes are sometimes planted and are hardy without winter protection. The fruit is small and sour, but acceptable for jelly.

Currants and Gooseberries ¹⁰

Such small fruits as currants and gooseberries are among the most valuable for the northern Great Plains. They should be included in every home fruit garden.

Currant varieties that have done well at the Northern Great Plains Field Station include London Market, Red Dutch, White Grape, Red Lake, and Perfection. The first three are small-fruited varieties that are hardy and productive. Red Lake and Perfection are large-fruited varieties having long clusters that are much easier to pick than the small clusters of the small-fruited varieties. The large-fruited varieties, however, are not quite so hardy and productive as the small-

¹⁰ Currant and gooseberry (ribes) plants are hosts of white pine blister rust, a destructive disease of white, or five-leafed, pines. The invasion of North America by the white pine blister rust has resulted in laws and quarantines prohibiting or regulating the shipment and growing of currant and gooseberry plants, in order to control the disease. For this reason persons desiring to grow or to ship currant and gooseberry plants should consult the State nursery inspector as to legal restrictions. Information is also available in Field Bulletin 1398, Currants and Gooseberries: Their Culture and Relation to White Pine Blister Rust.

fruited ones. Red Lake is the leading variety as far as sales in the area are concerned, and it is undoubtedly one of the best. Figure 30 shows London Market currants apparently suffering no winter injury, whereas Cherry currants in an adjacent row were killed back almost to the ground.

Cascade is a newer, large-fruited variety worthy of trial.

European black currant (*Ribes nigrum*) varieties are not recommended, because they are very susceptible hosts for white pine blister rust. State laws prohibit their planting in Montana, but not in North Dakota or South Dakota, where white pines are of little or no importance. At present Wyoming has no laws prohibiting the planting of *R. nigrum* although white pines are of considerable importance in that State.

In general, gooseberries have not been so hardy as currants during severe winters but have shown greater ability to endure summer drought. However, some varieties of gooseberries have been the equal of currants in hardiness. Standard varieties of gooseberries that have been planted widely over the northern Great Plains include Houghton, Carrie, Pixwell, and Oregon.

Houghton (fig. 31) is a red variety of small size, but good quality. The bush is fairly hardy and prolific, but the leaves are subject to leaf spot damage. Carrie is similar to Houghton in color, size, and quality of the fruit. The bush is vigorous, fairly hardy, and prolific, and less subject to leaf spot damage than Houghton. Because of fewer thorns and the position of the berries, Carrie (fig. 32) is easier than Houghton to pick.

Pixwell, a cross between Oregon and the native wild gooseberry of the Red River Valley (*Ribes missouriense*), was introduced by the North Dakota Agricultural Experiment Station. The fruit is small to medium in size, green or partly red when ripe, and of good quality. The bush is very hardy, vigorous, and prolific. It has marked resistance to leaf spot. Picking is easy as the bush is not very thorny and the berries hang down on long stems. Pixwell is gaining in popularity and is considered the best variety for general planting on the northern Great Plains.

The Oregon variety has not been hardy at Mandan. It winterkilled to the ground when the Houghton gooseberry in an adjacent row was not injured (fig. 31). It is suggested for trial under favorable conditions, however, because it produces medium-sized to large green fruit of fair to good quality.

Abundance, Perry, Kanega, Kataga, and Minnesota 2 are considered worthy of trial as they are hardy, resistant to leaf spot, and prolific. All bear larger fruit than Houghton and Carrie.

Raspberries and Blackberries

Raspberry canes are often killed to the ground unless they are bent over and covered with soil during the winter. They also suffer from drought in dry seasons, all varieties being killed outright during the drought of 1936. If possible, the raspberry grower should be prepared to irrigate when irrigation is needed. Despite these drawbacks many are not content to be without this fine fruit, and good crops of raspberries have been produced in favorable years. When the plants are properly covered with soil during the winter, Latham and New-



Figure 30.—Cherry currants winterkilled almost to ground (right) and uninjured London Market currants.



Figure 31.—Oregon gooseberries winterkilled to the ground (right) and uninjured Houghton gooseberries (left).



Figure 32.—A 3-year-old Carrie gooseberry loaded with fruit at the Northern Great Plains Field Station.

burgh have been two of the best red varieties under test. Chief is hardier, but the berries tend to be small under dry-land conditions. Other red varieties such as Sunrise, Indian Summer, Marcy, and Taylor seem to be worthy of trial although they have not been tested over a long period. Potomac and Ruddy are purple varieties that have yielded well in favorable seasons. Sodus, another purple variety, has yielded fair crops; but the canes are so vigorous that they are difficult to bend over and cover with soil for winter protection. Cumberland has been the best black raspberry under test.

Trailing blackberries are not generally recommended, but the variety Lucretia survives drought better than most raspberries and has produced light crops of fruit. Boysenberries have suffered considerable winter injury even when covered with soil during the winter and have not produced much fruit. Their planting is not advised.

Strawberries

Strawberries do well in the home fruit garden if irrigated and properly protected with a straw mulch during the winter. If water is not available, it is doubtful whether they have a place there, as the crop is often a failure under dry-land conditions. Recommended varieties of June-bearing strawberries are Dunlap and Howard 17 (Premier), and Burgundy, Majestic, and Robinson are suggested for trial. Gem, Progressive, Rockhill (Wayzata), and Evermore are good everbearing varieties; and Streamliner is suggested for trial. Sioux, a new variety introduced by the Cheyenne Horticultural Ex-

periment Station at Cheyenne, Wyo., bears smaller fruit than the varieties just mentioned, but the fruit is of good quality, and the plants are hardy without winter protection.

NATIVE FRUITS

A number of hardy native fruit plants are to be found in protected coulees and along streams throughout a large part of the northern Great Plains. People often drive long distances to pick such fruits and occasionally transplant young bushes from the wild to their yards or grow seedlings from particularly good wild plants.

Plums are of first importance among the native fruits, *Prunus americana* being the species common on the northern Great Plains. Named varieties of native plums have already been discussed (p. 43). The wild fruit is used for canning, jam, sauce, plum butter, and jelly, and for eating out of hand.

The Bessey cherry, or western sand cherry (*Prunus besseyi*), is not gathered so much in the wild as are some other native fruits. It seems to respond very readily to cultivation, both fruit and bush becoming much larger than they are ordinarily found in the wild state. Of those tested at the Northern Great Plains Field Station, Sioux, Champa, and Brooks have been the best. Because they have been hardy, drought-resistant, and usually prolific they are of value for the home garden. Sioux ripens earlier than any plum, is sweet and mild in flavor, and is good for pies and sauce. Champa may have some plum blood in it and belong in the cherry-plum-hybrid class, but it is a dwarf bush and so may be treated as a Bessey cherry. It appears to be hardy and prolific. Brooks is a newer introduction from Canada. The fruit is large, firm, and good. Other good varieties include Black Beauty, O'Kreek, and Weta. Figure 33 shows a fruiting branch of a Bessey cherry selection.

The common wild chokecherry (*Prunus virginiana* var. *melanocarpa*) is much sought after in the wild state because of the excellent jelly and wine that can be made with this fruit. Some so-called chokeless selections have had a limited sale on the market, but there are few named varieties of this fruit. Chokecherries may be used for an outside or inside row of the windbreak and may thus furnish both fruit and shelter. Figure 34 illustrates fruiting branches of the native chokecherry and shows its heavy production.

Native buffaloberries (*Shepherdia argentea*) also are good for jelly, although it is of light color and not so clear as some other fruit jellies. These berries are frequently gathered in the wild, being knocked from the trees onto blankets spread to catch them. But little work has been done to improve the buffaloberry, and few bushes are grown under cultivation for the fruit. Like the chokecherry and the plum, it may be used for an outside or inside row of the windbreak, where it will be of use for both shelter and fruit.

Serviceberries, also called Juneberries, saskatoons, and shadblows (*Amelanchier alnifolia*, *A. alnifolia* var. *pumila*, and *A. canadensis*), are native to the area and are often gathered from wild plants, the fruit being used for pies and sauce. The flavor is a little flat; hence currants or rhubarb are often mixed with serviceberries with very good results. The only named variety of serviceberry tested at the Northern Great Plains Field Station is Success. It is of fair size and



Figure 33.—Native Bessey cherry (*Prunus besseyi*) selection at the Northern Great Plains Field Station.



Figure 34.—Native chokecherry (*Prunus virginiana* var. *melanocarpa*) selection at the Northern Great Plains Field Station.

quality, hardy, and generally prolific. It has done very well and deserves a place in the home fruit garden. Selection and breeding work with serviceberries are in progress at the station.

The fruit of the native cranberrybush (*Viburnum trilobum*) is desirable for jelly. Some superior selections of this fruit were made by the late Mrs. Fanny Heath, of Grand Forks, N. Dak., and by the North Dakota Agricultural Experiment Station. However, this fruit does not withstand prolonged periods of drought, and it is recommended only for the more favorable sections of the northern Great Plains or for places where it is possible to irrigate.

Clove (golden, or yellow-flowering) currants (*Ribes odoratum*) (fig. 35) are sometimes picked in the wild and are grown for fruit and ornamental purposes. Very good jelly and jam can be made from them, and some persons like them in pies. A number of promising selections have been made at the Northern Great Plains Field Station and elsewhere, and the best of these are thought to be well worth planting in the home fruit garden of the northern Great Plains. They are very hardy, drought-resistant, and reliable yielders. An objection is the uneven ripening of the fruit.

Among other native fruits may be mentioned the American black currant (*Ribes americanum*), which is useful for jelly or jam; the native grape (*Vitis vulpina*), which is often gathered for making jelly, wine, or grape juice; and native gooseberries, raspberries, strawberries, and hawthorns. In figure 36 are shown fruiting branches of some native fruit plants.

PLANTING PLAN FOR THE HOME FRUIT GARDEN

Every farmer should make a planting plan of his fruit garden, so that he will have no difficulty in distinguishing the different varieties when they reach bearing age and will be able to draw conclusions as to which are adapted to his locality.

An example of such a plan appears in figure 37. Such details as the size and shape of the fruit garden, the varieties selected, and the distances of planting will vary with the conditions on each farm. In the plan shown, rows of apples and crabs are 25 feet apart, rows of plums and cherry-plum hybrids 20 feet apart, and rows of small fruits 10 feet apart. The row containing serviceberries (Juneberries) and Bessey cherries is spaced 15 feet from the row containing cherry-plum hybrids on one side and 10 feet from the row of small fruits on the other. Apples and crabs are spaced 25 feet apart in the row; plums 15 feet; cherry-plum hybrids, apricots, and cherries 13 feet; Bessey cherries, serviceberries, clove currants, and grapes 8 feet; and raspberries, gooseberries, and currants 5 feet.

The following planting list for a farm fruit garden of about an acre is suggested for well-protected sites in those districts of the northern Great Plains that have a comparatively long growing season. The rows are numbered from south to north and the varieties listed from east to west in the rows.

Row 1.—1 Florence crab, 2 Virginia crabs, 2 Whitney crabs, 2 Dolgo crabs.

Row 2.—1 Mantet apple, 2 Oldenburg apples, 2 Wealthy apples, 2 Haralson apples.

Row 3.—2 Red Coat plums, 2 Manet plums, 2 Waneta plums, 2 Bounty plums, 1 Underwood plum, 1 Tecumseh plum, 1 Ember plum.



Figure 35.—Clove currant (*Ribes odoratum*) selection at the Northern Great Plains Field Station.



Figure 36.—From left to right are shown fruiting branches of native chokecherry (*Prunus virginiana* var. *melanocarpa*), clove currant (*Ribes odoratum*), Bessey cherry (*Prunus besseyi*), and buffaloberry (*Shepherdia argentea*).

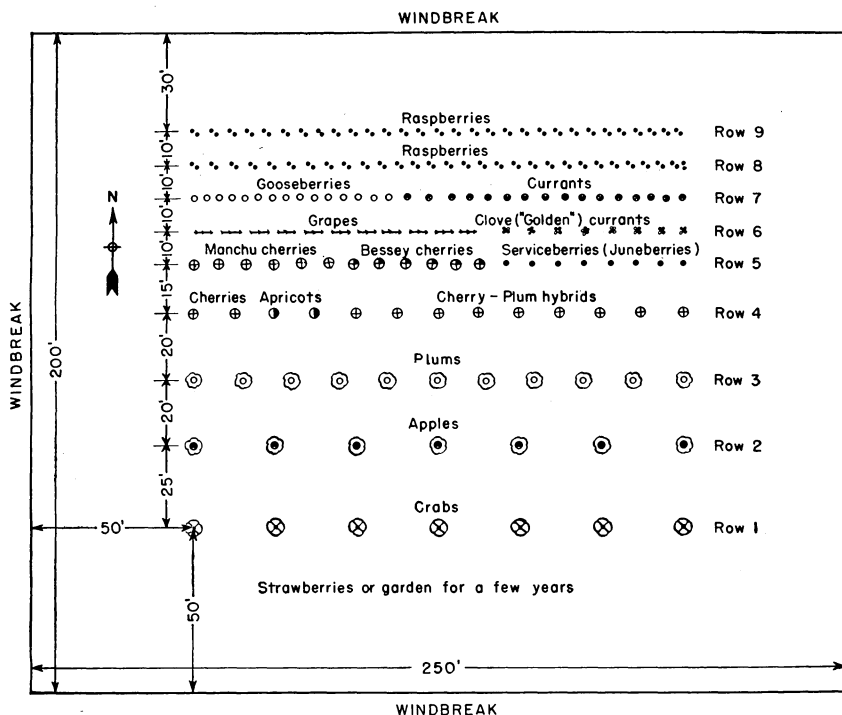


Figure 37.—Planting plan for a home fruit garden of about an acre.

Row 4.—2 Compass cherry-plum hybrids, 3 Opata cherry-plum hybrids, 2 Sapa and 2 Manor cherry-plum hybrids, 1 Scout apricot, 1 Manchurian apricot, 1 Coronation cherry, 1 Bessarabian cherry.

Row 5.—5 Success serviceberries, 3 Dwarf or other serviceberries, 3 Brooks Bessey cherries, 3 Champa Bessey cherries, 3 Drilea Manchu cherries, 3 Orient Manchu cherries.

Row 6.—8 Clove currants, 6 Beta grapes, 5 Suelter grapes.

Row 7.—5 Perfection currants, 6 Red Lake currants, 5 White Grape currants, 5 Carrie gooseberries, 10 Pixwell gooseberries.

Row 8.—15 Latham raspberries, 15 Newburgh raspberries.

Row 9.—15 Cumberland black raspberries, 15 Potomac purple raspberries.

Strawberries or garden crops may be grown in the space between the fruit trees and the windbreak for several years, especially if water for irrigation is available. Such crops should not be planted closer than 10 feet to the fruit or windbreak trees. Suggested varieties of strawberries are Dunlap and Howard 17 (June-bearing) and Gem and Evermore (everbearing).

If the site of the proposed fruit garden is not very well sheltered or if the district has an unusually severe climate or a comparatively short growing season (for the northern Great Plains), changes in the suggested variety list will be necessary. For such conditions the following varieties are suggested for trial:

Apples.—Yellow Transparent, Mantet, Oldenburg.

Crab apples.—Dolgo, Silvia, Transcendent, Robin, Florence, and Amur.

Plums and plum and cherry-plum hybrids.—Bounty, Assiniboin, Manet, Minnesota 89, Teton, Wyant, Pembina, Waneta, Compass, and Opata.
Serviceberries (Juneberries).—Success and some others for cross-pollination.
Bessey cherries.—Sioux, Champa, and Brooks.
Apricots.—None.
Cherries.—None.
Pears.—None.
Currants.—London Market, Red Dutch, and White Grape.
Gooseberries.—Carrie, Houghton, and Pixwell.
Raspberries.—Chief.
Native fruits.—Clove currants, chokecherries, native grapes, and others.

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